New Jersey
Department of Environmental Protection

Mid-Course Review for the New Jersey Portion of the Philadelphia-Southern New Jersey and New York-Northern New Jersey 1-Hour Ozone Nonattainment Areas

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Acronyms and Abbreviations

CO	Carbon Monoxide
CSP	Compliance Supplemental Pool
NAAQS	National Ambient Air Quality Standard
NJDEP	New Jersey Department of Environmental Protection
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
OTC	Ozone Transport Commission
PPM	Parts Per Million
SIP	State Implementation Plan
TPD	Tons per Day
USEPA	United States Environmental Protection Agency
VMT	Vehicles Miles Traveled
VOC	Volatile Organic Compound

Executive Summary

The purpose of this mid-course review is to assess if New Jersey's nonattainment areas are making reasonable progress toward attainment of the ozone National Ambient Air Quality Standards (NAAQS), with a focus on ensuring progress is being made consistent with needs for the 8-hour ozone NAAQS.

Substantial progress has been made in reducing emissions in New Jersey. Notwithstanding the need for further reductions in ozone precursors from sources upwind of New Jersey, the data presented demonstrate that New Jersey is making great progress, in terms of controls on local sources, in reducing ozone precursor levels and ozone concentrations and exceedances in the region. In addition, New Jersey should realize substantial benefits from implementation of the NO_x Budget Program in the upwind non-OTC states in 2005. However, more progress will be needed to attain the 8-hour ozone standard.

Some of the key findings of this review include:

1. Preliminary 2004 ozone concentrations indicate there were no exceedances of the 1-hour ozone standard and the fewest number of 8-hour ozone exceedance days since averages have been calculated in New Jersey. The 2004 ozone season's low ozone concentrations were due, in part, to unusual meteorology, i.e. low summer temperatures and above average precipitation.

2. Ozone exceedances in New Jersey are declining while there is no significant trend in the occurrence of days of 90° or greater, i.e. changing meteorology is not driving the ozone trend.

3. New Jersey has implemented all emission reductions required by the 1990 Clean Air Act, and all volatile organic compounds reductions required by the USEPA shortfall analysis. The control measure to address oxides of nitrogen required by the USEPA shortfall analysis was proposed on September 20, 2004, the hearing held on October 28, 2004, and the comment period closed on November 19, 2004.

1.0 Introduction

The purpose of a mid-course review is to assess if a nonattainment area is or is not making progress toward attainment of the 1-hour ozone National Ambient Air Quality Standard (NAAQS).[1] Given the designation of 8-hour ozone nonattainment areas in 2004 and the revocation of the 1-hour ozone NAAQS in 2005, the focus of the mid-course review is shifting slightly. The United States Environmental Protection Agency (USEPA) recently stated in its *Final Rule To Implement the 8-Hour requirements. Phase 1 Ozone National Ambient Air Quality Standard—Phase 1* [2] that,

> "…rather than using these [mid-course] reviews to ensure areas meet the 1-hour NAAQS (which will have been revoked), States and [US]EPA can use these reviews to ensure progress is being made consistent with needs for the 8-hour NAAQS."

This document outlines the various databases and procedures the New Jersey Department of Environmental Protection (NJDEP) used in its mid-course review for the Philadelphia-Southern New Jersey and New York-Northern New Jersey 1-Hour Nonattainment Areas, hereafter referred to as the Philadelphia Nonattainment Area and the New York Nonattainment Area, respectively. This review is presented in two sections, the first regarding the Philadelphia Nonattainment Area and the second the New York Nonattainment Area.

This reviews shows that New Jersey is making significant progress, in terms of controls on local sources (but not with respect to upwind sources), in meeting the ozone NAAQSs. Population, labor force and economic indicators are up while emissions have decreased and air quality has improved substantially. In addition, New Jersey should realize substantial benefits from response to the NO_x SIP Call in the upwind non-Ozone Transport Commission (OTC) states in 2005. However, more progress will be needed to attain the 8-hour ozone standard.

2.0 Philadelphia Nonattainment Area

The Philadelphia Nonattainment Area is a multi-state nonattainment area that was defined shortly after enactment of the 1990 Clean Air Act Amendments Amendments and is comprised of fourteen counties; five from Pennsylvania, two from Delaware, one from Maryland and six from New Jersey. Table 1 lists all the counties that are included in the Philadelphia Nonattainment Area. Figure 1 is a map of the 1-hour ozone nonattainment areas with which New Jersey is associated.

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[1] USEPA, memo entitled *Mid-Course Review Guidance for the 1-Hour Ozone Nonattainment Areas that Rely on Weight-of-Evidence for Attainment Demonstration*, March 28, 2002.
[2] 69 FR 23951 (2004)

Table 1. Philadelphia-Southern New Jersey 1-Hour Ozone Nonattainment Area

STATE	COUNTY
Delaware	Kent
	New Castle
Maryland	Cecil
New Jersey	Burlington
	Camden
	Cumberland
	Gloucester
	Mercer
	Salem
Pennsylvania	Bucks
	Chester
	Delaware
	Montgomery
	Philadelphia

2.1 Emission Reduction Review

New Jersey has implemented statewide, all emission control programs mandated by the 1990 Clean Air Act Amendments as well as additional control measures needed to attain the 1-hour ozone standard.[3] Additional control measures have been adopted to address the ozone emission reduction shortfall identified by the USEPA.[4] All volatile organic compound (VOC) emission reduction strategies required to address the shortfall have been adopted by New Jersey and those strategies have been submitted to the USEPA as revisions to the State Implementation Plan (SIP) (Table 2). The control measure to address oxides of nitrogen required by the USEPA shortfall analysis was proposed on September 20, 2004, the hearing held on October 28, 2004, and the comment period closed on November 19, 2004. Emission trends are summarized in the Trends Analysis section, 2.2.6, of this report.

[3] State of New Jersey, *State Implementation Plan Revision for the Attainment and Maintenance of the 1-Hour Ozone National Ambient Air Quality Standard – Update to Meeting the Requirements of the Alternative Ozone Attainment Demonstration Policy: Additional Emission Reductions, Reasonably Available Control Measure Analysis, and Mid-Course Review*, 2001

[4] 67 FR 5152 (2002)

Figure 1: Existing 1-Hour Ozone Nonattaiment Area

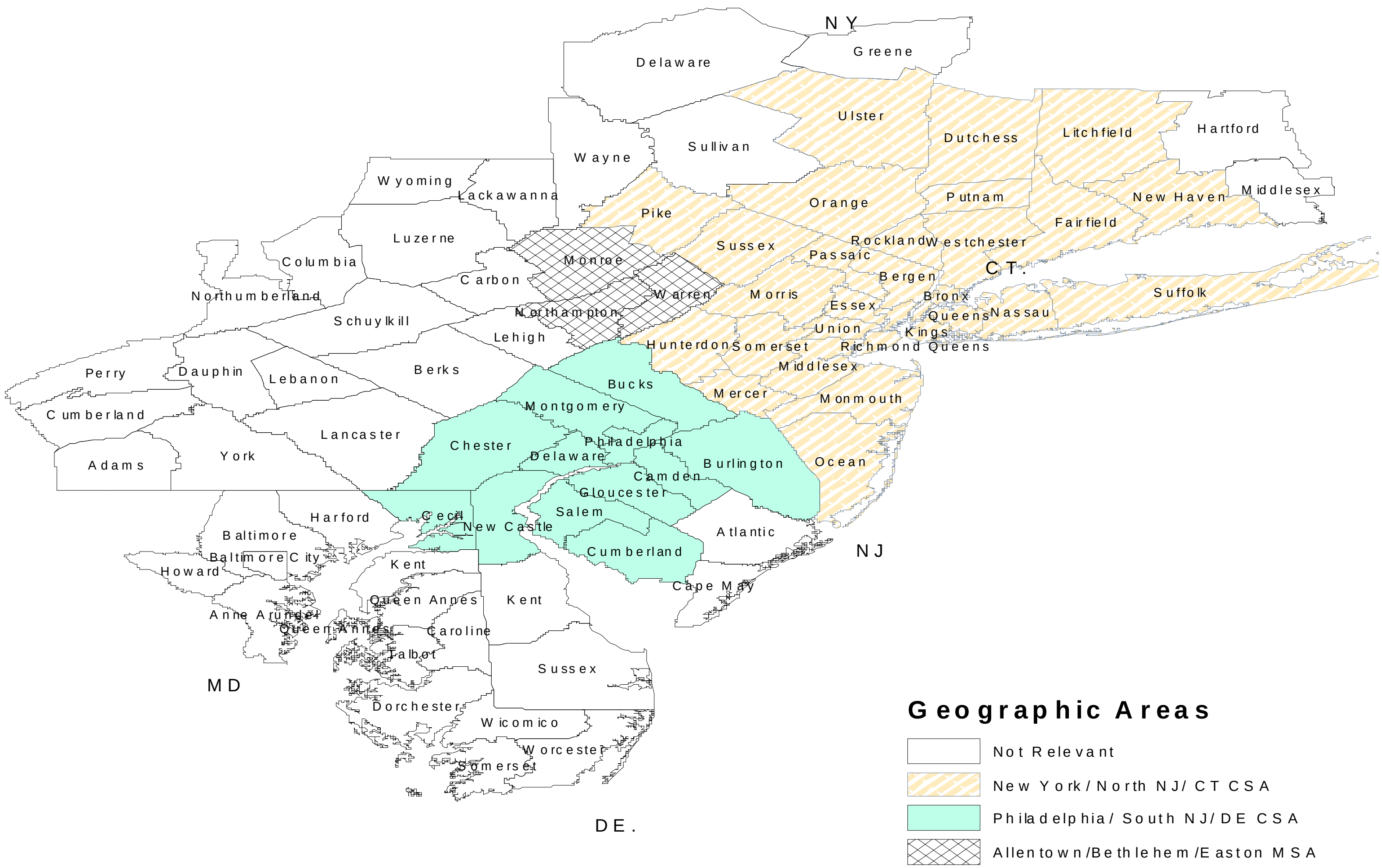


Table 2. Recently Adopted Emission Reduction Strategies

Control Measure	Date of Adoption	Operative Date
Consumer Products	April 7, 2004	June 6, 2004
Portable Fuel Containers	April 7, 2004	June 6, 2004
Architectural & Industrial Maintenance Coatings	May 21, 2004	July 20, 2004
Mobile Equipment Refinishing	April 30, 2003	June 29, 2003
Solvent Cleaning Operations	April 30, 2003	June 29, 2003

In addition to implementing all mandated and shortfall control measures, the NJDEP has finalized a major consent decree with an electrical generator with facilities in Mercer and Hudson Counties. To meet the terms of this decree, the generator will install selective catalytic reduction or other Best Available Control Technology that would produce equivalent reductions at the 3 units. These reductions will occur in 2004 and 2007.

New Jersey submitted a final SIP revision[5] in 2003, which revised its 2005 and 2007 onroad motor vehicle emission budgets for the New Jersey portion of the Philadelphia Nonattainment Area and the New Jersey portion of the New York Nonattainment Area using the new MOBILE6 model.

The MOBILE6 emission inventories showed increases in both the VOC and NO_x values relative to prior SIP budgets. The increases were due primarily to certain changes in the MOBILE model that updated our understanding of emissions from mobile sources. The model changes that contributed most significantly to the increases were likely the enhanced ability of the MOBILE model to account for emission increases due to vehicle acceleration and air conditioning. Although MOBILE5 accounted for the effects of vehicle acceleration by basing emissions on certain standard drive cycles, emission factors generated by MOBILE6 are based on drive cycles that are designed to more closely match real world driving conditions. In addition, the adjustments to emission factors due to air conditioning more accurately represent actual conditions than factors in MOBILE5.

This SIP revision showed that, although the new levels of onroad motor vehicle emissions calculated using MOBILE6 were higher, the relative reductions in onroad emissions between the base year and the attainment year were found to be greater under the MOBILE6 model for the New Jersey portions of both the Philadelphia and New York Nonattainment Areas. Therefore, both nonattainment areas were still predicted to achieve attainment by their current attainment dates and there was no need to adopt any additional control measure at the time of the MOBILE6 SIP revision.

[5] State of New Jersey, *New Jersey Revised Motor Vehicle Emission Inventories and Transportation Conformity Budgets Using the MOBILE6 Model*, 2003

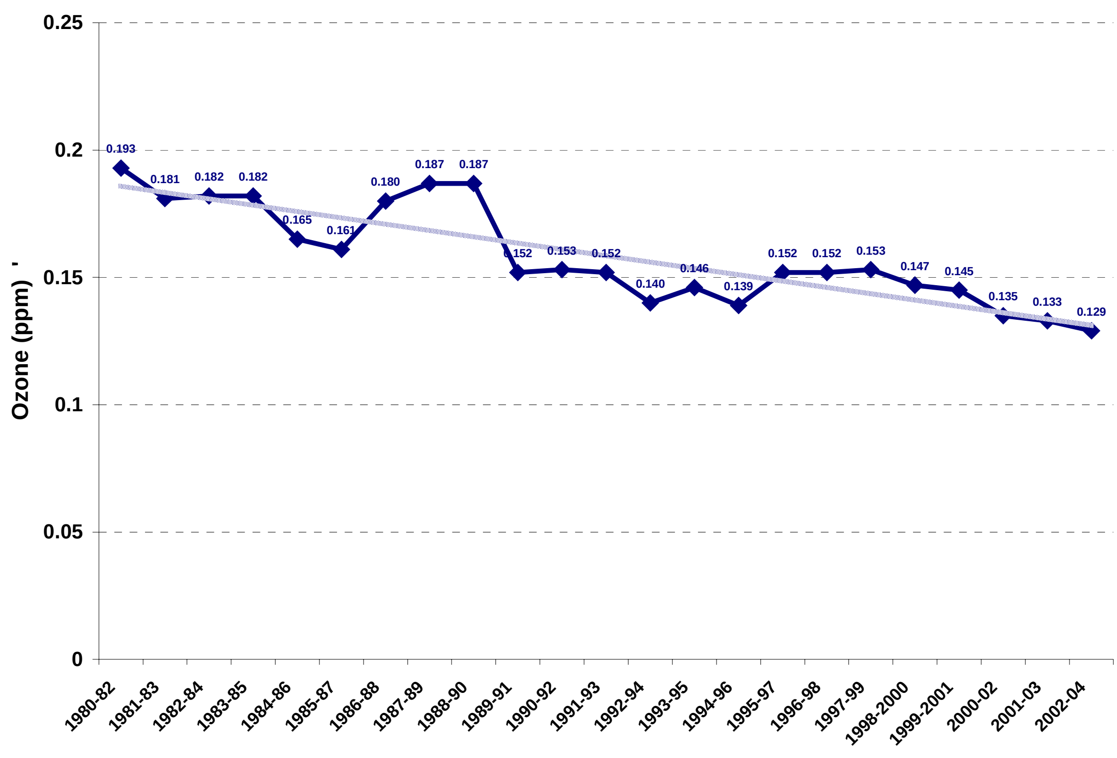
2.2 Trends analysis

Various data are analyzed for trends to determine the Philadelphia Nonattainment Area's and New Jersey's progress in attaining the 1-hour ozone NAAQS. The trends analyzed include: 1-hour ozone design values, monitor exceedances, air quality data, meteorology, emissions, population, labor, and economic. Trends are analyzed from 1980 through 2004. One-hour ozone data was extracted from the USEPA's online AIRS database. This allows for a comparison of pre 1990 Clean Air Act Amendments conditions to post 1990 Clean Air Act Amendments conditions.

2.2.1 Philadelphia Nonattainment Area 1-Hour Ozone Design Values

Figure 2 displays the 1-hour ozone design values for the fourteen county Philadelphia Nonattainment Area from 1982 to 2004. This is the maximum monitor design value for all monitors within the Philadelphia Nonattainment Area. Only monitors with 3-years of valid 1-hour ozone concentrations were used. These design values do not include 1-hour ozone concentrations for July 8th and 9th, 2002. Many northeastern states have flagged this data as an exceptional event due to the influence of the northern Quebec forest fires. For consistency, all data for these dates was removed from this analysis. Figure 3 is a map of ozone monitoring sites in New Jersey.

Figure 2. Design Values Philadelphia-Southern New Jersey 1-Hour Ozone Nonattainment Area 1982-2004



One-hour ozone design values in the Philadelphia Nonattainment Area have declined substantially. Average design values from 1991-2004 have declined ~18% from average design values from 1982-1990 (pre 1990 Clean Air Act Amendments).

It should be noted that the monitor at Colliers Mills in Ocean County, New Jersey has a preliminary 2004 1-hour ozone design value of 0.134 ppm.[6] Ocean County is part of the New York 1-hour ozone Nonattainment Area. The Colliers Mills monitor was not present at the time the 1-hour ozone nonattainment designations were made in 1990. The Colliers Mills site replaced a monitor located six miles away at McGuire Air Force Base in Burlington County. Burlington County is part of the Philadelphia 1-hour ozone Nonattainment Area. The Colliers Mills data is presented here as indicative of downwind air quality.

2.2.2 Philadelphia Nonattainment Area 1-Hour Ozone Monitor Exceedances

The total number of monitor exceedances of the 1-hour ozone standard for the fourteen county Philadelphia Nonattainment Area between 1980 and 2004 are shown in Figure 4. Monitor exceedances occur whenever a monitor's 1-hour ozone concentration is greater than or equal to 0.125 parts per million (ppm).[7] There has been a dramatic decrease in the number of monitored exceedances since 1980. The average number of monitored exceedances from 1991-2004 declined ~76% from the average number of exceedances between 1980-90. This decrease cannot be attributed to a change in the number of monitors in the Philadelphia Nonattainment Area since the number of ozone monitors has remained relatively steady, increasing slightly from sixteen monitors in 1980 to eighteen monitors in 2004. In 2004, there were no exceedances of the 1-hour ozone standard in the Philadelphia Nonattainment Area. This is the first time in the past two decades this has happened.

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[6] This design value does not include 1-hour ozone values for some days in July, 2002 due to the influence of Northern Quebec forest fires. If this data were included, the design value at Colliers Mills would be 0.145 ppm.

[7] As used here, monitor exceedance is the sum across the network of each monitor's individual number of exceedance days in a given year.

Figure 3: 2003 New Jersey Ozone Monitoring Network

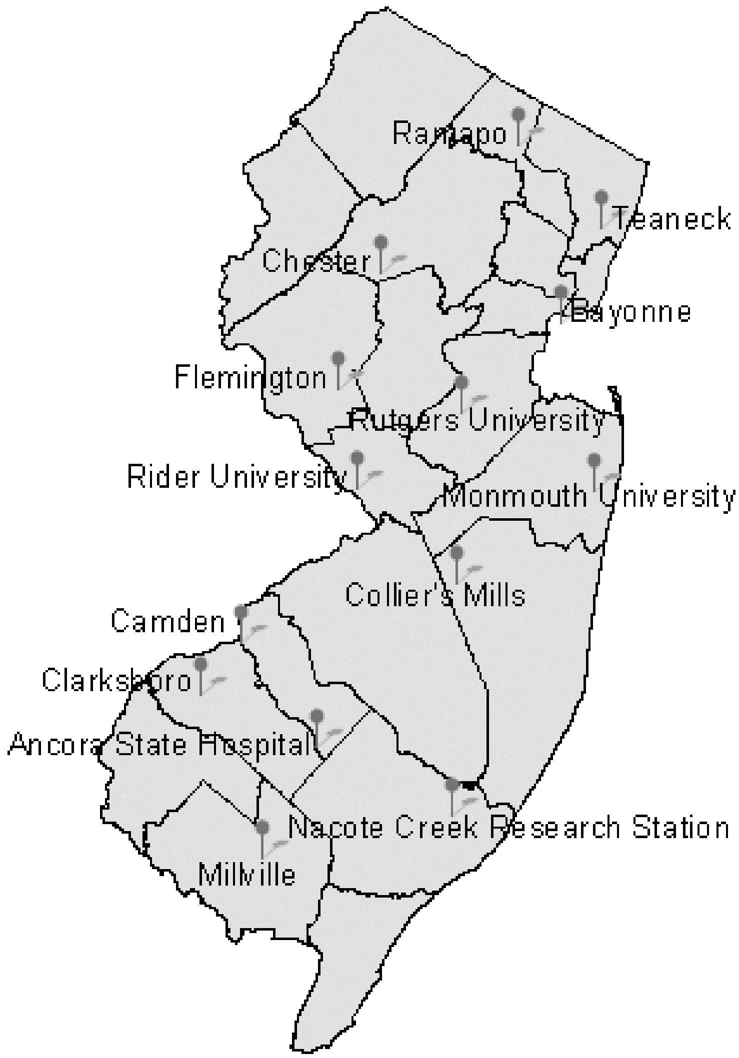
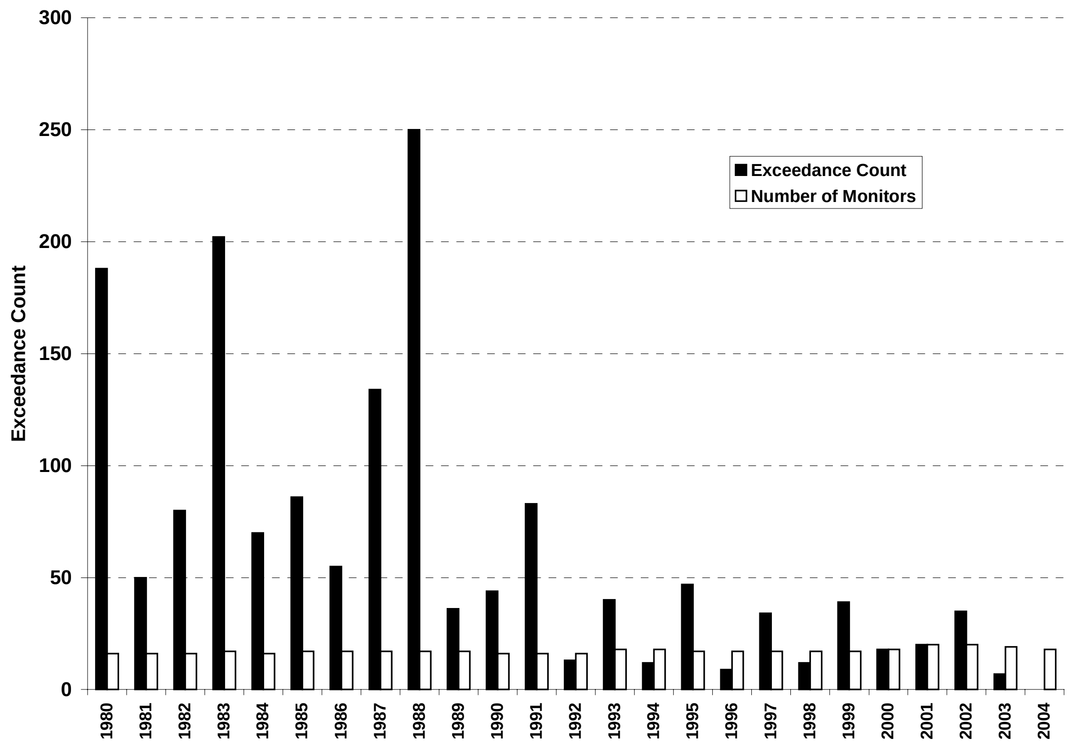


Figure 4. Monitored Exceedances Philadelphia-Southern New Jersey 1-Hour Ozone Nonattainment Area 1980-2004



2.2.3 New Jersey Monitor Trends

One-hour ozone trends were analyzed for the five New Jersey ozone monitors within the Philadelphia Nonattainment Area. Four of the monitors operated during the 1980-2004 time period; the fifth monitor, at Millville, started operation in 1981. Historically, there have been between two and five ozone monitors operating in the six county New Jersey portion of the Philadelphia Nonattainment Area. Currently, there are five monitors operating. Three of the five monitors currently operating in New Jersey's portion of the Philadelphia Nonattainment Area have design values which exceed the 1-hour ozone standard. They are Camden Lab in Camden County (0.128 ppm), Clarksboro in Gloucester County (0.127 ppm) and Rider University in Mercer County (0.126 ppm). These values are close to the 2004 1-hour design value for the entire Philadelphia Nonattainment Area, 0.129 ppm at Fair Hills, Maryland. The design value for an entire nonattainment area is the monitor in the nonattainment area with the highest design value. The Philadelphia Nonattainment Area's current design monitor is Fair Hill, Cecil County, Maryland which is upwind of most of the major emission sources in the nonattainment area. This monitor is therefore more likely responding to emissions from the Baltimore-Washington D.C. Nonattainment Area.

It should be noted that another monitor was present in the New Jersey portion of the Philadelphia Nonattainment Area at the time the 1-hour ozone nonattainment classifications were made in 1990. That monitor was located at McGuire Air Force Base in Burlington County. Subsequent to the 1-hour ozone nonattainment designations, the monitor at McGuire Air Force Base was relocated 6 miles away in Colliers Mills, Ocean County which is part of the New York Nonattainment Area. This relocation took place because the monitor could no longer be accommodated at McGuire Air Force Base. Colliers Mills is upwind of most of the major emission sources in the New York Nonattainment Area. This monitor is therefore more likely responding to emissions from the Philadelphia Nonattainment Area. The preliminary 2004 1-hour ozone design value for Colliers Mills is 0.134 ppm.[8]

Table 3 lists current 1-hour ozone design values, average design values for 1982-90 and 1991-2004, and the percent change for all monitors in the six county New Jersey portion of the Philadelphia Nonattainment Area. These periods were chosen to gauge the effects of emission controls imposed by the 1990 Clean Air Act Amendments. Design values have fallen ~13-21% from average pre 1990 Clean Air Act Amendments levels.

Table 3. 1-Hour Ozone Design Values in the Six County New Jersey Portion of the Philadelphia Nonattainment Area

Monitor	2004 Design Value* (ppm)	Average 1982-90 DesignValue (ppm)	Average 1991-2004 DesignValue (ppm)	% Change
Ancora	0.122	0.151	0.130	-14%
Camden Lab	0.128	0.160	0.126	-21%
Clarksboro	0.127	0.161	0.127	-21%
Millville	0.116	0.137	0.119	-13%
Rider University	0.126	0.167	0.134	-20%

* Preliminary

Table 4 lists the average number of 1-hour exceedances prior to and after enactment of the 1990 Clean Air Act Amendments. There have been significant reductions in the number of 1-hour ozone exceedances for the five monitors in the six county New Jersey portion of the Philadelphia Nonattainment Area. Average 1-hour exceedances reductions range from ~62-84%.

[8] This design value does not include 1-hour ozone values for some days in July, 2002 due to the influence of Northern Quebec forest fires. If this data were included, the design value at Colliers Mills would be 0.145 ppm.

Table 4. 1-Hour Ozone Exceedances in the Six County New Jersey Portion of the Philadelphia Nonattainment Area

Monitor	Average 1980-90 Exceedances (Per Year)	Average 1991-2004 Exceedances (Per Year)	% Change
Ancora	7.3	2.1	-72%
Camden Lab	10.8	2.0	-82%
Clarksboro	7.4	2.5	-66%
Millville	4.1	0.6	-84%
Rider University	9.1	3.4	-62%

Table 5 lists the changes in peak 1-hour ozone and 8-hour ozone values for the five monitors in the six county New Jersey portion of the Philadelphia Nonattainment Area that had continuous 1-hour measurements between 1980 and 2004 or continuous 8-hour measurements between 1986 and 2004. Post 1990 Clean Air Act Amendments average peak 1-hour ozone values have decreased by ~12-27% from pre 1990 values. Post 1990 Clean Air Act Amendments average peak 8-hour ozone values have decreased by ~9-16% from pre 1990 values. (The 8-hour ozone standard is 0.080 ppm.)

Table 5. Peak 1-Hour and 8-Hour Ozone Concentrations in the Six County New Jersey Portion of the Philadelphia Nonattainment Area

	Peak 1-Hour Ozone Values (ppm)			Peak 8-Hour Ozone Values (ppm)		
Monitor	Yearly Average 1980*-1990	Yearly Average 1991-2004	% Change	Yearly Average 1986-1990	Yearly Average 1991-2004	% Change
Ancora	0.155	0.136	-12%	0.136	0.118	-13%
Camden Lab	0.166	0.130	-22%	0.130	0.112	-13%
Clarksboro	0.168	0.132	-14%	0.126	0.114	-9%
Millville	0.140	0.122	-13%	0.127	0.107	-16%
Rider University	0.185	0.135	-27%	0.140	0.117	-16%

* The monitor at Millville started in 1981

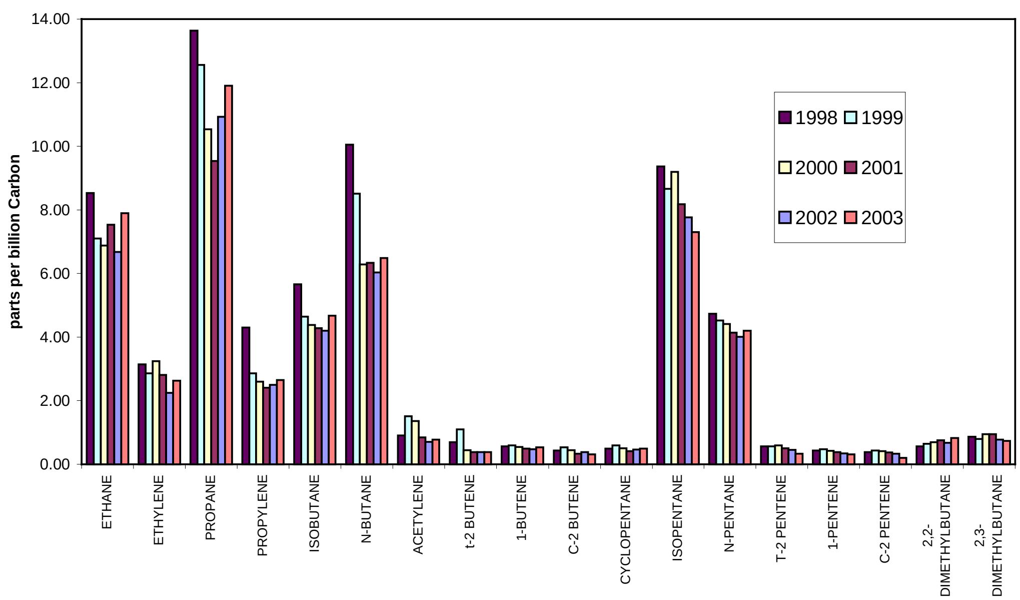
These declines are similar to reductions observed throughout the entire 1-hour ozone nonattainment area.

2.2.4 Other New Jersey Air Quality Trends

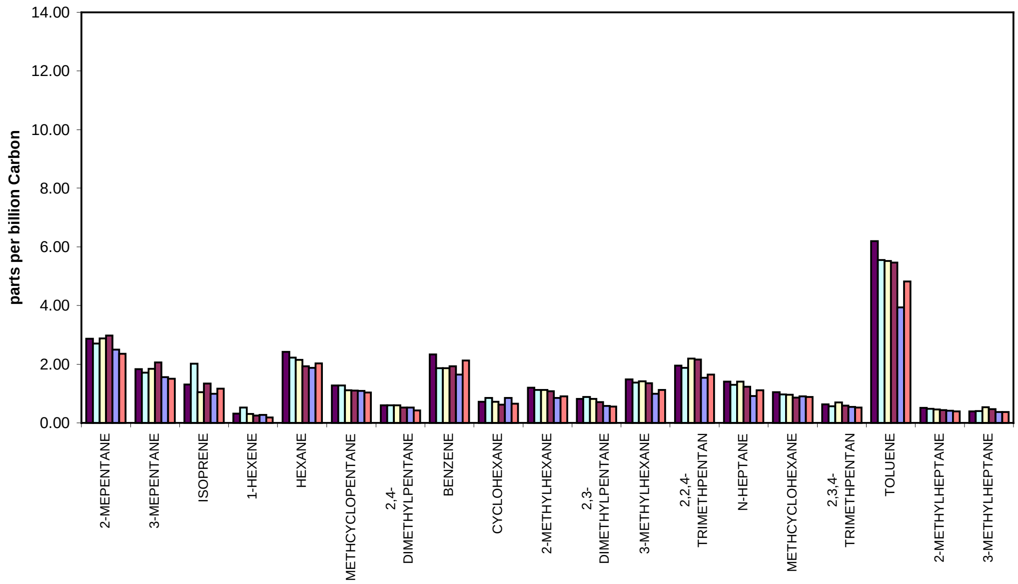
2.2.4.1 Volatile Organic Compounds

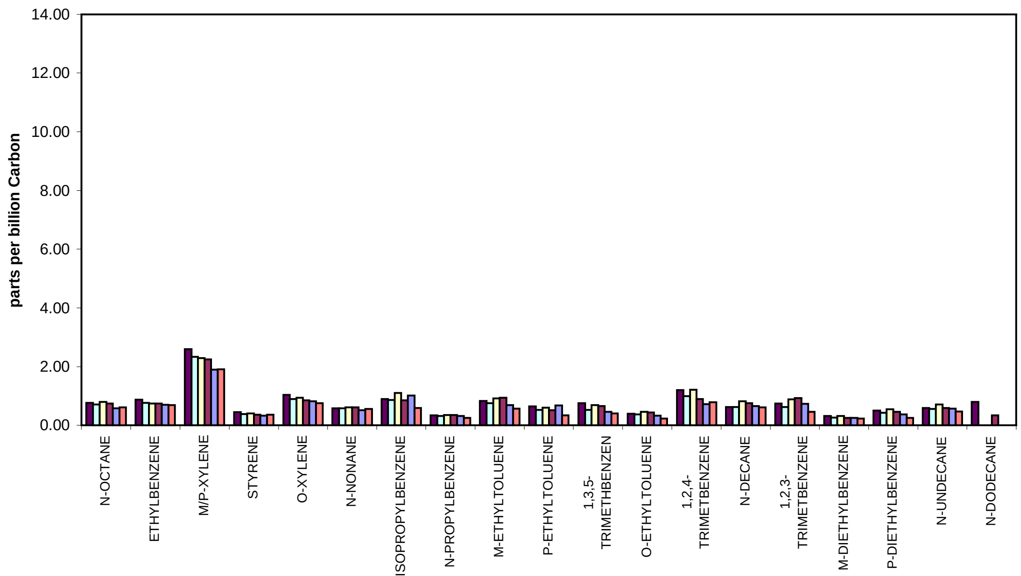
Ozone is formed when NO_x and VOCs react in the presence of sunlight. Federal revisions to air monitoring regulations required states to enhance monitoring for ozone and its precursors.[9] Some data for ambient concentrations of VOCs are gathered through the Photochemical Assessment Monitoring Stations (PAMS) program. The objectives of this program include providing a speciated ambient air database which is both representative and useful for ascertaining ambient profiles and distinguishing among various individual VOCs and which is characteristic of source emission impacts. Currently, only six years of speciated VOC data have been collected through the PAMS program. Although this is insufficient data to comment on the long term trends in this data, as shown in Figure 5, it appears that progress is being made in quantifying these compounds and some significant reductions are being recorded.

Figure 5: Camden PAMS Summer Averages, 1998-2003



[9] 58 FR 8468 (1993)



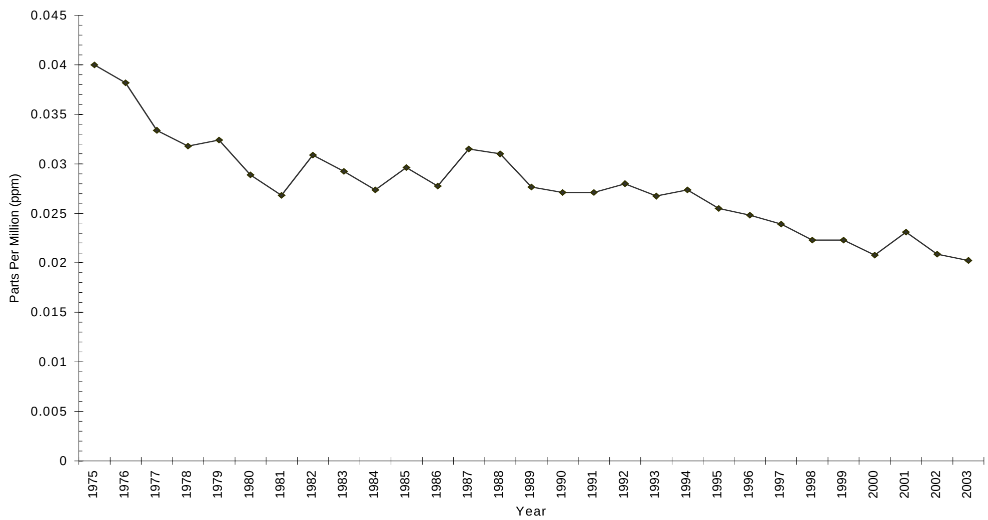


2.2.4.2 Nitrogen Dioxide

Nitrogen dioxide (NO_2) is a reddish-brown, highly reactive gas that is formed in the air through the oxidation of nitric oxide (NO). NO_x is a mixture of gases comprised mostly of NO and NO_2. These gases are emitted from the exhaust of motor vehicles, the burning of coal, oil or natural gas, and during industrial processes such as welding, electroplating and dynamite blasting. Although most NO_x is emitted as NO, it is readily converted to NO_2 in the atmosphere. In the troposphere, near the Earth's surface, NO_2, not molecular oxygen, provides the primary source of the oxygen atoms required for ozone formation.

New Jersey monitored NO_2 and NO levels at eleven locations in 2003. As Figure 6 shows, NO_2 levels have decreased dramatically from 1975-2003.

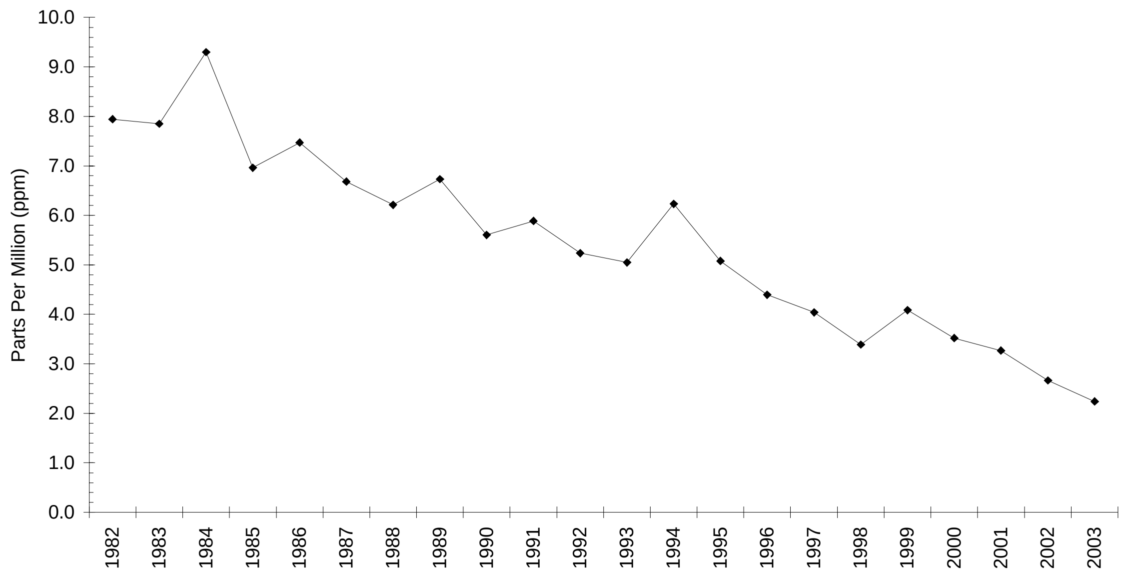
Figure 6. New Jersey Nitrogen Dioxide Air Quality, 1975-2003
Annual Average



2.2.4.3 Carbon Monoxide

Carbon monoxide (CO) is a by-product of mobile vehicle/equipment exhaust, industrial processes, fuel combustion in sources such as boilers and incinerators, and natural sources such as forest fires. CO is an ozone precursor produced as a result of incomplete combustion. The oxidation of CO results in a net production of carbon dioxide and ozone. New Jersey monitored CO levels at thirteen locations in 2003. The NAAQSs for CO are 35 ppm for the 1-hour standard and 9 ppm for the 8-hour standard. The last time the CO NAAQSs were exceeded in New Jersey was January of 1995 and the entire state was officially declared as having attained the CO standard on August 23, 2002. As Figure 7 shows, CO levels has decreased dramatically from 1982 to 2003.

Figure 7. New Jersey Carbon Monoxide Air Quality, 1982-2003
2nd Highest 8-Hour Average



2.2.5 Meteorological Trends

As previously stated, ozone is not emitted directly to the atmosphere, but is formed by photochemical reactions between VOCs and NO_x in the presence of sunlight. The long, hot, humid days of summer are particularly conducive to ozone formation, and as such ozone levels are of general concern during the months of May through September. Correlations can be made between ozone concentrations and metrological variables such as the number of days of 90º or greater, average temperature, precipitation and precipitation days. Hot dry summers usually produce long periods of elevated ozone concentrations while ozone production is usually limited to cool and wet summers.

Meteorological data from the Philadelphia International Airport was reviewed to determine any trends between 1-hour ozone values and summertime weather conditions. Precipitation totals and the number of days of 90º or greater have remained relatively unchanged between 1980 and 2004. Precipitation frequency (number of days with measurable precipitation), however, has increased slightly.

There have been a number of unusually warm summers during the 1980-2004 time period. These include 1983, 1988, 1991, 1995, and 2002. Table 6 lists meteorological data for these unusually warm years, along with the average design values for the time periods encompassing the year and the number of monitor exceedances within the Philadelphia Nonattainment Area. Examining design values and monitor exceedances from these warm summers indicate both values are declining over time.

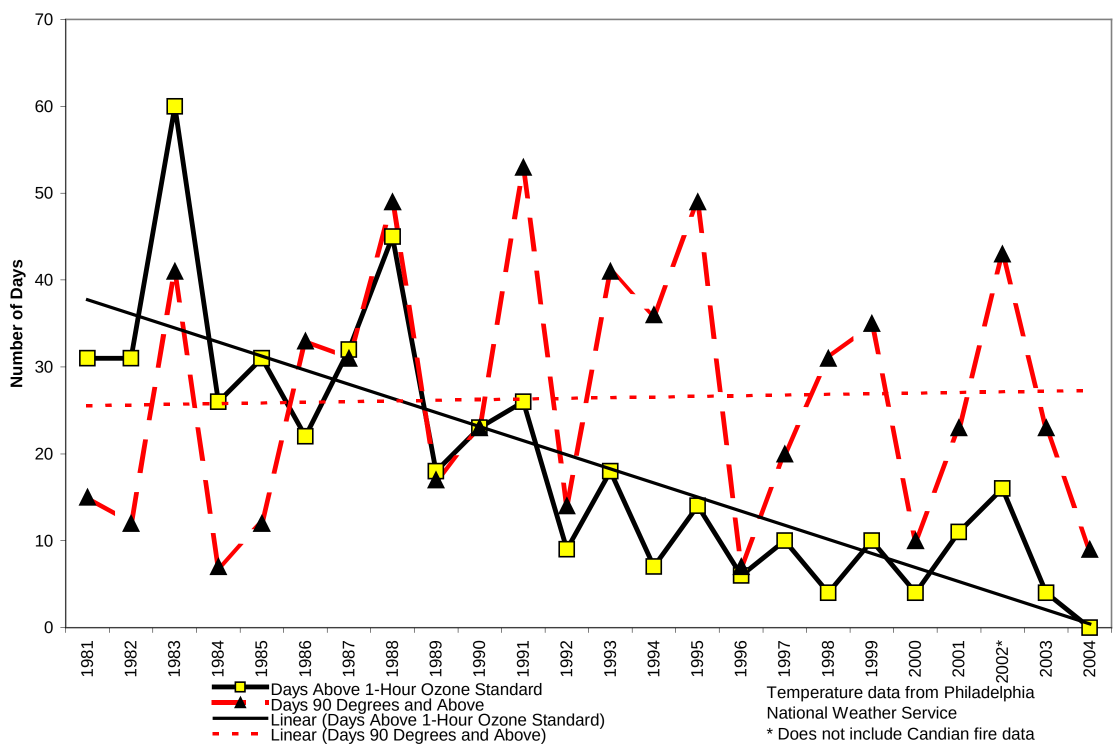
Table 6. Comparison of Warm Summers
Philadelphia International Airport 1980-2004

Year	90º Days	Precipitation (inches)	Precipitation days	Average Design Value* (ppm)	Monitor Exceedances**
1983	41	13.98	40	0.182	202
1988	49	19.69	48	0.185	250
1991	53	17.43	42	0.152	83
1995	49	10.78	42	0.146	47
2002	43	12.06	34	0.132	35
Avg	47	14.79	41.2		

*****Average for year included in the design value calculation. For example, for 1988, the average design value is the average of the 1986-8, 1987-9 and 1988-90 design values.
****** As used here, monitor exceedance is the sum across the network of each monitor's individual number of exceedance days in a given year.

Trends between 1-hour ozone exceedances and summertime hot days (of 90°or greater) in New Jersey are shown in Figure 8. This shows that ozone exceedances are declining, while there is no significant trend in the occurrence of hot days, i.e. changing meteorology is not driving the ozone trend.

Figure 8. New Jersey 1-Hour Ozone "Unhealthy" Days vs. "Hot Days"



2.2.6 New Jersey Portion of the Philadelphia Nonattainment Area Emission Projections

Anthropogenic emissions[10] in the New Jersey portion of the Philadelphia Nonattainment Area are summarized in Table 7. There are significant projected reductions in ozone precursor emissions from local sources since enactment of the 1990 Clean Air Act Amendments. NO_x and VOC emissions from the six county New Jersey portion of the Philadelphia Nonattainment Area are expected to decrease by half between 1990 and 2005.

In addition, a series of control measures applicable to New Jersey sources adopted in 2003 and 2004 (see Section 3.1) will generate more emission reductions in the 2005 to 2007 timeframe. Recently adopted federal mobile control measures, such as onroad heavy duty diesel engine standards, nonroad diesel engine standards, and spark ignition Phase 2 engine standards, will start to phase in over the next several years and will generate substantial emission reductions.

Table 7. Emissions Rates from New Jersey Portion of Philadelphia Nonattainment Area Rate of Progress Report NO_x and VOC Emissions in Tons Per Day (TPD) Burlington, Camden, Cumberland, Gloucester, Mercer and Salem Counties

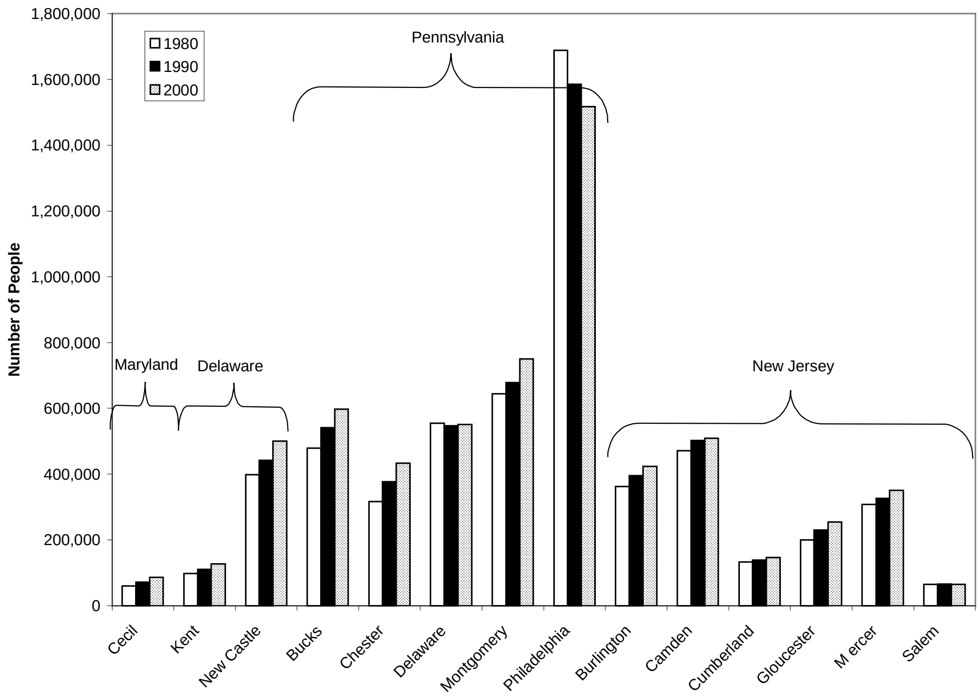
VOC		NO_x	
1990	**2005**	**1990**	**2005**
358 TPD	184 TPD	446 TPD	199 TPD
% Reduction	49 %	**% Reduction**	55%
Average % of Total VOC and NO_x Reduction		52%	

2.2.7 Philadelphia Nonattainment Area Population Trend

Census data for 1980, 1990 and 2000 were used to determine population trends within the Philadelphia Nonattainment Area. As shown in Figure 9, between 1980 and 2000 the fourteen counties that comprise the Philadelphia Nonattainment Area grew by ~9%, adding over half a million people. Percentage wise, New Jersey's portion of the Philadelphia Nonattainment Area's population grew by ~14% or ~209,000 people. The largest percentage changes occurred in the Maryland and Delaware portions of the nonattainment area. Population growth was slightly higher for the 1990-2000 time frame than the 1980-90 time frame for most counties except in New Jersey. Emission reductions have occurred within the nonattainment area even though there have been significant increases in population.

[10] State of New Jersey, *State Implementation Plan Revision for Attainment and Maintenance of the Ozone National Ambient Air Quality Standard-New Jersey 1996 Actual Emission Inventory and Rate of Progress Plans for 2002, 2005 and 2007*, 2001

Figure 9. Population Trend
Fourteen County Philadelphia 1 Hour Ozone Nonattainment Area

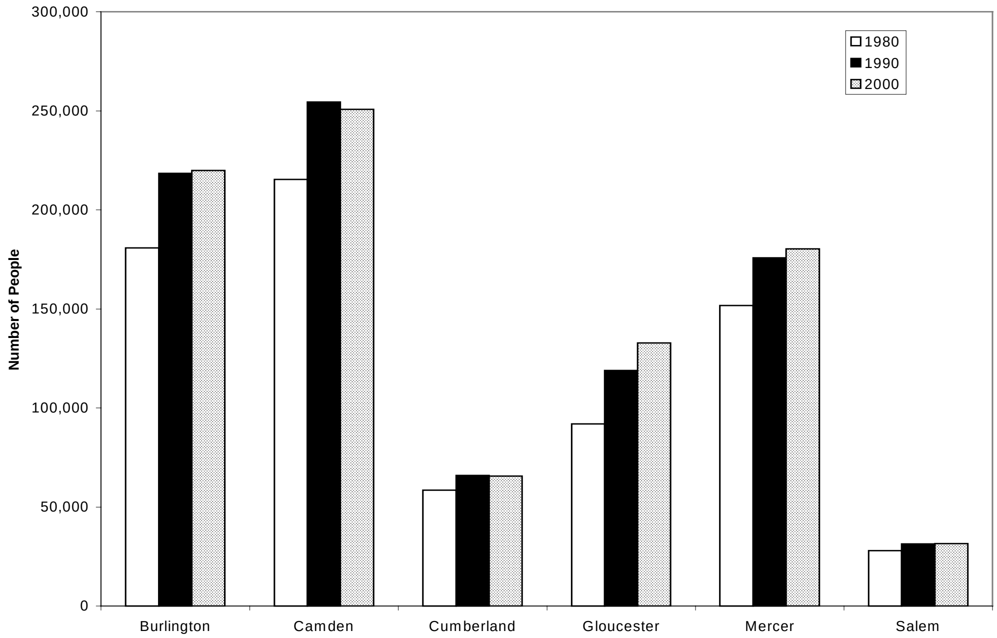


2.2.8 New Jersey Labor Force Trend

Estimates of the six county New Jersey portion of the Philadelphia Nonattainment Area's labor force, from the New Jersey Department of Labor, were examined to determine any trends. Figure 10 shows that the six county New Jersey area's estimated labor force has increased ~21% between 1980 and 2000. This increase is larger than the 14% increase in population between 1980 and 2000. During the 1980-2000 time period the six county New Jersey area's population increased by ~209,000 people while the estimated labor force increased by ~154,000 laborers. Overall the population in the labor force has remained fairly constant, ~47% in 1980 to ~50% in 2000. Burlington, Gloucester and Mercer counties had over 50% of their populations in the labor force in 2000.

The majority of the increase in the estimated labor force took place between 1980 and 1990, as did the majority of the population increase. Economic indicators from the Philadelphia Federal Reserve (see Section 2.2.9) indicate New Jersey's economy expanded during both decades. Labor force expansion during the 1980s, however, appear to be approximately nine times greater than what occurred during the 1990s even though economic indices indicate expansion was about the same during the 1980s. The effects of labor force changes in the six county New Jersey portion of the Philadelphia Nonattainment Area on regional emissions are unknown. However, one could speculate that increases in the labor force might affect the total VMT in the region.

Figure 10. Estimated Labor Force
in Six County New Jersey Portion of the Philadelphia Nonattainment Area

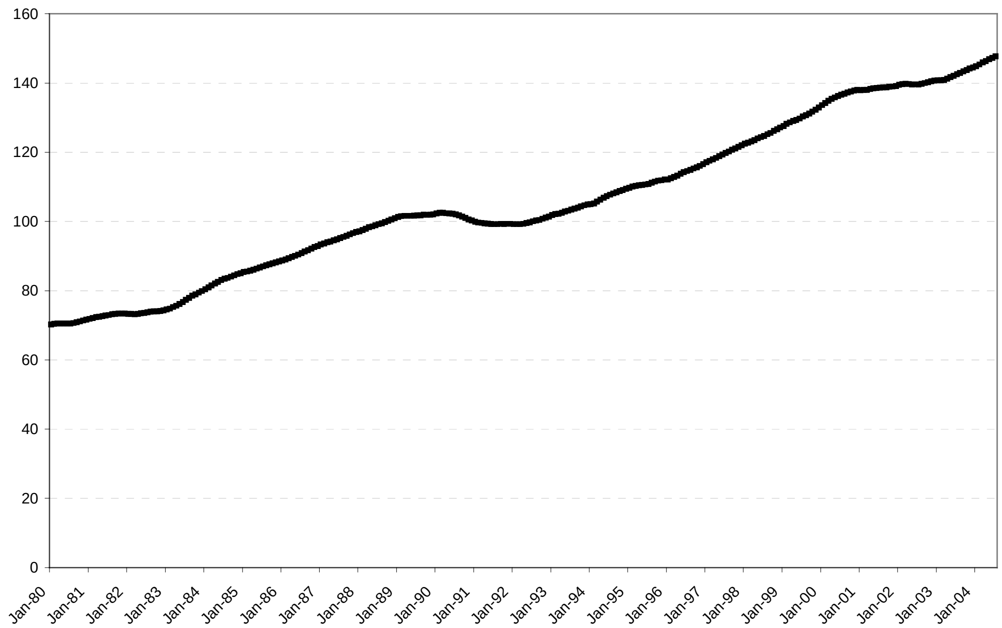


2.2.9 New Jersey Economic Indicator Trend

Economic indices compiled by the Philadelphia Federal Reserve Bank were examined to gauge New Jersey's economic activity. Emissions are undoubtedly tied to economic activity and would likely increase during periods of robust economic growth and stagnate during periods of recession. Figure 11 shows New Jersey's economic activity index for New jersey from 1980 through July 2004.

Periods of heightened economic activity in the State occurred during the late 80s and the late 1990s through the early 2000s. Economic growth slackened from 1991-94 and from 2002-03. Economic trends and their relationship to ozone concentration levels have generally not been examined.

Figure 11. New Jersey Economic Activity Index
1980 – July 2004



Data fom Philadelphia Federal Reserve Bank
http://www.phil.frb.org/econ/eai/

2.3 Ozone Transport Analysis

Ozone transport has a significant effect on ozone concentrations within the Philadelphia Nonattainment Area. This was clearly demonstrated in a recent study that was coincidentally conducted during the August 2003, blackout in the Midwest and northeast.[11] Airborne observations over central Pennsylvania on August 15, 2003, ~24 hours into the blackout, revealed large reductions in SO_2 (>90%), ozone (~50%) and light scattered particles (~70%) relative to measurements outside the blackout region and over the same location when power plants were operating normally. At the time of the blackout, reported SO_2 and NO_x emissions from upwind power plants were down to 34 and 20% of normal, respectively. Ozone decreased by ~0.038 ppm. This clean air benefit was realized over parts of the northeast.

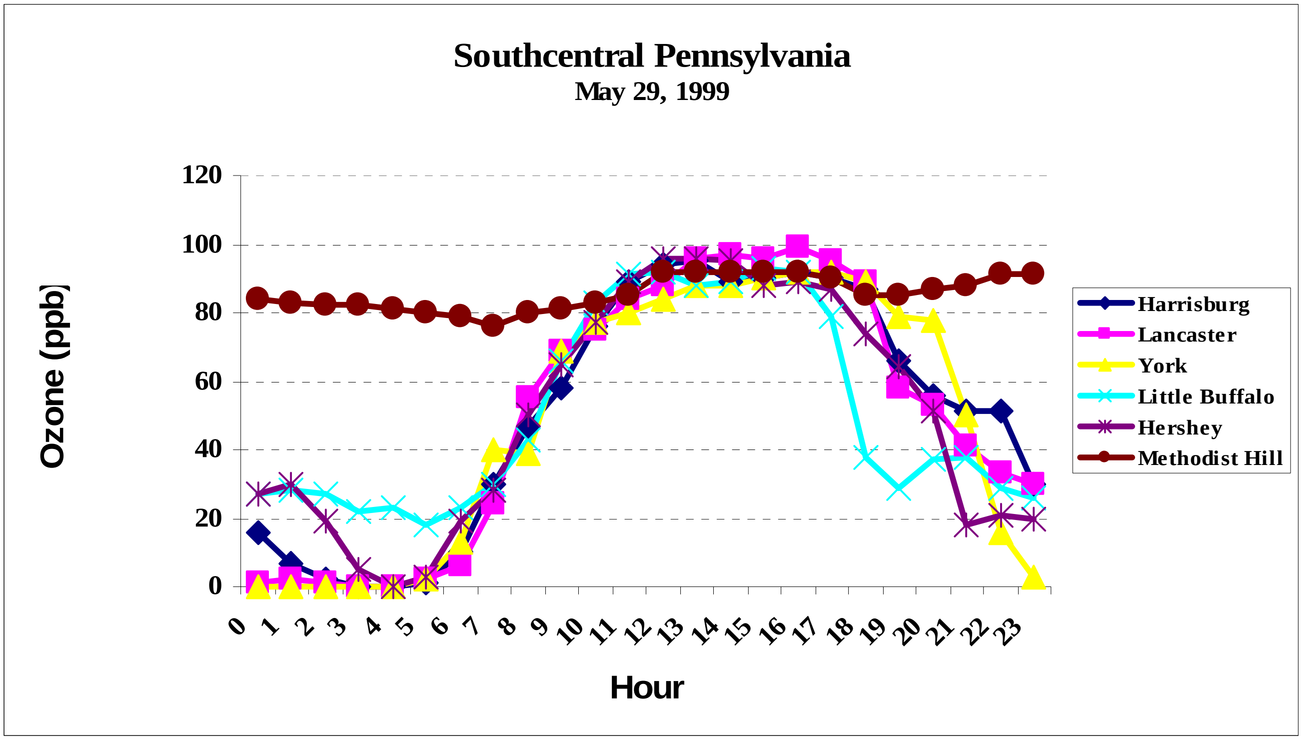
A qualitative assessment is made on large-scale regional transport, short-term local transport and transport via low-level jets into the Philadelphia Nonattainment Area. The results of that analysis are discussed in detail in the following.

[11] Marufu, L.T., et.al., "The 2003 North American Electrical Blackout: An accidental experiment in atmospheric chemistry", *Geophysical Research Letters*, 2004, v. 31

2.3.1 Regional Ozone Transport Assessment

Pennsylvania has operated a high altitude ozone monitor (~1900 ft) at Methodist Hill on South Mountain in south central Pennsylvania (Franklin County) since the mid 1990s. Figure 12 shows what happens when these regional plumes enter south central Pennsylvania. Ozone concentrations at the high elevation monitor, Methodist Hill, remain high during the overnight hours. Ozone concentrations at the low-level monitors remain low until the morning temperature inversion breaks up. Atmospheric mixing incorporates the regional pool of ozone and ozone concentrations rise rapidly to match those of the high elevation monitor. This process has also been documented in the Philadelphia region.[12]

Figure 12. Effect of Urban Ozone Plumes



Unfortunately, there are a limited number of monitoring sites with long term data to gauge the effects of long-range ozone transport in Pennsylvania. Ozone data from Perry County's Little Buffalo State Park monitor was used to gauge regional ozone transport. Perry County is located northeast of Franklin County. Little Buffalo has a continuous ozone record between 1980 and 2004. The monitor is isolated from emission sources due to its rural nature and blockage from the Blue Mountain Ridge located south of the monitor.

[12] Northeast Oxidant and Particle Study (NEOPS) – Final Report to the Commonwealth of Pennsylvania, 2003

Changes in design values, exceedances and peak values at the Little Buffalo monitor, for the monitors in the Philadelphia Nonattainment Area and for the monitors in the New Jersey portion of the Philadelphia Nonattainment Area were examined over the 1980 and 2004 time period. Again, the analysis was divided into periods before and after enactment of the 1990 Clean Air Act Amendments. The results of this analysis, as well as the average values for the six county New Jersey portion of the Philadelphia Nonattainment Area, are shown in Table 8.

Table 8. Regional Transport Analysis using Little Buffalo, Pennsylvania

1-Hour Ozone Design Values
Little Buffalo vs. Philadelphia 1-Hour Nonattainment Area

Monitor	2004 Design Value* (ppm)	Average 1982-90 Design Value (ppm)	Average 1991-2004 Design Value (ppm)	% Change
Little Buffalo	0.098	0.117	0.105	-10%
Philadelphia Nonattainment Area**	0.129	0.175	0.144	-18%

* Preliminary
** The monitor at Fairhills, Cecil County, Maryland

1-hour Ozone Exceedances
Little Buffalo vs. Six County New Jersey Portion of the Philadelphia Nonattainment Area

Monitor	Average 1980-90 Exceedances (per year)	Average 1991-2004 Exceedances (per year)	% Change
Little Buffalo	1.0	0.0	-100%
New Jersey Portion*	7.2	2.1	-71%

* Average exceedances per monitor (total number of exceedances) number of monitors)

Peak 1-Hour Ozone Concentrations
Little Buffalo vs. Six County New Jersey Portion of the Philadelphia Nonattainment Area

	Peak Value (ppm)		
Monitor	**Yearly Average 1980-1990**	**Yearly Average 1991-2004**	**% Change**
Little Buffalo	0.116	0.107	-7%
New Jersey Portion	0.163	0.131	-20%

The data from Little Buffalo suggests a reduction in regional ozone concentrations transported into the Philadelphia Nonattainment Area. Much of the reductions observed at Little Buffalo are due to elevated ozone concentrations from one year (1988). This suggests that the 1990 Clean Air Act Amendments reductions in regions upwind of Philadelphia have done little to reduce large-scale regional ozone transport.

Preliminary data from the 2004 ozone season indicates ozone concentrations were the lowest since monitors were installed in the early 1970s. Meteorological factors such as lower than normal temperatures and above average precipitation in the Philadelphia region contributed to low ozone measurements. In addition, temperatures over much of the Midwest were well below normal that suppressed ozone production in this upwind region and therefore, background ozone concentrations entering eastern Pennsylvania were very low.

2.3.2 Regional Ozone Transport – NO_x SIP Call

The regional nature of ozone formation and transport has been recognized for some time.[13,14] On September 27, 1994, the OTC[15] agreed to develop a regional program to achieve significant reductions in NO_x emissions from large combustion sources. This program called for the establishment of a NO_x cap and trade program, and the establishment of an emissions cap or "budget" that all affected sources must not exceed during each control period, beginning in 1999. The program further called for a multi-phase approach to the budget calculation. The first phase essentially involved the NO_x Reasonably Available Control Technology requirements of the Clean Air Act Amendments for ozone nonattainment areas. The second phase was a budget cap commencing in 1999. A third phase was a more stringent cap that commenced in 2003.

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[13] National Research Council, *Rethinking the Ozone Problem in Urban and Regional Air Pollution*, National Academy Press, 1991
[14] OTAG final report: http://www.USEPA.gov/ttn/rto/otag/finalrpt
[15] The Ozone Transport Commission includes the states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia and the District of Columbia

In the late 1990s, the USEPA determined that NO_x emissions from sources and emitting activities in twenty three jurisdictions significantly contribute to the nonattainment of the 1-hour ozone NAAQS, or will contribute to the nonattainment of the 1-hour ozone NAAQS in one or more downwind states in the eastern portions of the United States.[16,17,18] The USEPA issued the NO_x SIP call requiring affected states to amend their SIPs and limit NO_x emission from May 1 to September 30 of each year starting in 2003.

Due to legal challenges the initial deadline for emission reductions under the NO_x SIP call was delayed until May 31, 2004. However, since the OTC states already had the OTC NO_x Budget Program in place, all the OTC states implemented the cap on May 1, 2003, except for New Hampshire which is not affected under the NO_x SIP call. A 2003 progress report on the NO_x Budget Program recently released by the USEPA states that the OTC states' ozone season NO_x emissions in 2003 from power plants and other large combustion sources were reduced by 30% from 2002 levels and were 18% less than the number of NO_x Budget Program allowances allocated in 2003.[19] In addition, NO_x highest daily emissions and average daily emissions in the OTC states have decreased ~25% and ~35%, respectively, from 1997 to 2003.[20]

NO_x Budget Program states other than the OTC states did not commence caps until May 31, 2004. The USEPA 2003 report states that:

> "A comparison of 2003 emissions with 2004 budgets demonstrates that some additional reductions will be necessary for these states to eventually reach their budgets."

The report further states that:

> "Due to litigation, the 2004 control period for these states began on May 31, instead of May 1. The allowance allocations for 2004, however, are based on a full five-month ozone season. Because of the shorter control period in 2004 and CSP [compliance supplemental pool] allowances distributed in 2004 to help sources comply with the program, [US]EPA anticipates that these states will have to achieve only modest reductions in 2004 to comply with the program. In 2005 and subsequent years, the control period will begin May 1, and deeper reductions will be necessary."

No update for 2004 has been issued on the implementation of the NO_x Budget Program in the non-OTC states. However, given the USEPA's statement that only modest reductions were needed in 2004 for these sources to comply with the NO_x Budget Program, it is unlikely that the OTC states saw much, if any, air quality benefit from the implementation of the NO_x Budget Program in the non-OTC states in 2004. Therefore, implementation of the NO_x Budget Program in the non-

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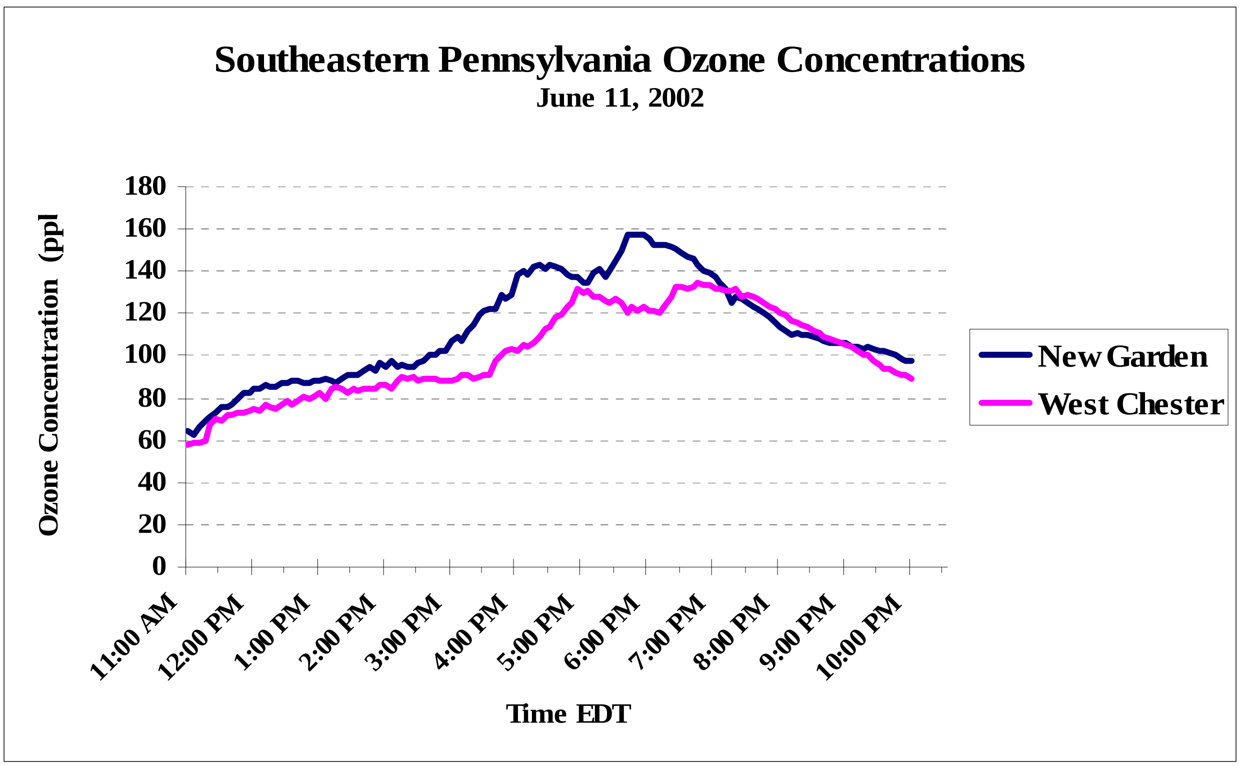
[16] 62 FR 60317 (1997)
[17] 63 Fed. Reg. 25902 (1998)
[18] 63 Fed. Reg. 57356 (1998)
[19] USEPA, *NOx Budget Trading Program-2003 Progress and Compliance Report*, EPA-430-R-04-010, 2004
[20] 1997 and 1998 data from Acid Rain Program; 1999-2002 data from OTC trading program; 2003 data from NBP

OTC states should only begin to provide substantial air quality benefits in the Philadelphia Nonattainment Area in 2005.

2.3.3 Short Term Local Ozone Transport Assessment

Ozone transport within the lower boundary layer into the Philadelphia Nonattainment Area is another important process. Unlike regional transport, local transport occurs over shorter distances and affects a smaller area. This process includes the low-level ozone plumes that emanate from the large metropolitan areas in the northeast. Ozone plumes from Baltimore and Philadelphia have been observed migrating downwind. Figure 13 shows the Baltimore ozone plume impacting monitors in southern Chester County, Pennsylvania forming a "double peak". The first peaks are due to the Baltimore ozone plume as it travels northeast towards Philadelphia. The second peak at West Chester occurred near sunset. Baltimore plumes have been observed moving across southern Pennsylvania and under ideal conditions reaching monitors in the Lehigh Valley well after sunset.[21] This area is generally upwind of the major emission sources in Philadelphia but downwind of emission sources in Baltimore and Washington D.C.

Figure 13. Plume Impact on Ozone Monitors in Southern Chester County



[21] Pennsylvania Department of Environmental Protection, *Ozone Exceedance Report: Lancaster, Reading and Allentown Regions*, 1999

2.3.4 Ozone Transport Via Low-Level Jets

Ozone transport via low-level jets is a relatively recent discovery. Low-level jets are nocturnal phenomena that have the potential for moving large pools of ozone in the lower boundary layer. Low-level jets are similar to large-scale regional transport with ozone moving above the surface then mixing down to the surface shortly after sunrise. Many of the vertical wind profilers in the northeast have observed low-level jets during the summer including the Northeast Oxidant and Particle Study site in northeast Philadelphia County. [22, 23]

Low-level jets form shortly after sunset when large-scale synoptic features are weak. Winds within these jets typically come from the south and may shift to the southwest towards daybreak. Wind speeds in the core of these jets can reach up to 15 m/s or nearly 35 mph. These jets have the potential to move ozone laden air several hundred miles during the overnight hours. The nature of low-level jets makes it difficult to quantify their contribution to ozone transport into the Philadelphia Nonattainment Area.

2.4 Summary and Conclusions

2.4.1 Trends Summary

- New Jersey has implemented all the emission reductions required by the 1990 Clean Air Act Amendments, and all volatile organic compounds reductions required by the USEPA shortfall analysis. The control measure to address oxides of nitrogen required by the USEPA shortfall analysis was proposed on September 20, 2004, the hearing held on October 28, 2004, and the comment period closed on November 19, 2004.
- One-hour ozone design values in the Philadelphia Nonattainment Area have declined substantially in the past two decades. Average 1-hour ozone design values in the Philadelphia Nonattainment Area from 1991-2004 have declined ~18% from average design values from 1982-1990 (pre 1990 Clean Air Act Amendments).
- The average number of monitored exceedances in the Philadelphia Nonattainment Area from 1991-2004 declined ~76% from the average number of exceedances between 1980-90 (pre 1990 Clean Air Act Amendments).
- Preliminary 2004 ozone concentrations indicate there were no exceedances of the 1-hour ozone standard in the Philadelphia Nonattainment Area. This is the first time in the past two decades this has happened.

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[22] Verghese, S.J. et. al., "Characterization of Nocturnal Jets Over Philadelphia During Air Pollution Episodes", *Proceedings of the American Meteorological Society 5th Conference on Atmospheric Chemistry*, 2003

[23] Willitsford, A. et. al., "Development of an Air Pollution Event During the NEOPS-DEP 2002 Investigation", *Proceedings of the American Meteorological Society 5th Conference on Atmospheric Chemistry*, 2003

- The Philadelphia Nonattainment Area's preliminary 2004 1-hour ozone design value is 0.129 ppm at Fair Hill, Cecil County, Maryland which is upwind of most of the major emission sources in the Philadelphia Nonattainment Area.
- The preliminary 2004 design value downwind of the Philadelphia Nonattainment Area is 0.134 ppm at Colliers Mills, New Jersey[24]
- Based on 2002, 2003 and preliminary 2004 1-hour ozone data, design values for three of the five monitors in New Jersey's portion of the Philadelphia Nonattainment Area currently exceed the 1-hour ozone standard. They are Camden Lab in Camden County (0.128 ppm), Clarksboro in Gloucester County (0.127 ppm) and Rider University in Mercer County (0.126 ppm).
- Average design values from 1991-2004 at the five ozone monitors in the New Jersey portion of the Philadelphia Nonattainment Area have decreased ~13-21% from the average design value between 1980-90 (pre 1990 Clean Air Act Amendments).
- The average number of monitored exceedances from 1991-2004 for the five monitors in the six county New Jersey portion of the Philadelphia Nonattainment Area have decreased ~62-84% from the average monitored exceedances between 1980-90 (pre 1990 Clean Air Act Amendments).
- Post 1990 Clean Air Act Amendments average peak values from 1991-2004 for the five monitors in the six county New Jersey portion of the Philadelphia Nonattainment Area have decreased by ~12-27% from the average peak values from 1980-1990 (pre 1990 Clean Air Act Amendments).
- Dramatic decreases in ozone precursors, VOC, NO_2 and CO, have been documented.
- Ozone exceedances in New Jersey are declining while there is no significant trend in the occurrence of days of 90° or greater, i.e. changing meteorology is not driving the ozone trend.
- NO_x and VOC emissions from the six county New Jersey portion of the Philadelphia Nonattainment Area are estimated to decrease by approximately half between 1990 and 2005.
- Emission reductions have occurred and air quality has improved within the Philadelphia Nonattainment even though the population in the Philadelphia Nonattainment Area has increased by over half a million people (~9%) and the six county New Jersey portion of the Philadelphia Nonattainment Area's estimated labor force has increased approximately 154,000 laborers (~21%) between 1980 and 2000.
- Regional ozone concentrations measured at Little Buffalo State Park in Perry County, Pennsylvania have shown little decrease since enactment of the 1990 Clean Air Act Amendments.
- The 2004 ozone season's unusually low values were the result of unusually low summer temperatures and above average precipitation. Reductions in

[24] This design value does not include 1-hour ozone values for some days in July, 2002 due to the influence of Northern Quebec forest fires. If this data were included, the design value at Colliers Mills would be 0.145 ppm.

regional transport due to weather conditions may also have contributed to this summer's unusually low ozone concentrations.

- Post 1990 Clean Air Act Amendments average peak 8-hour ozone values in the New Jersey portion of the Philadelphia Nonattainment Area have decreased by ~9-16% from pre 1990 values.
- The Philadelphia Nonattainment Area continues to be impacted by regional transport.

2.4.2 Philadelphia Nonattainment Area 1-Hour Ozone Air Quality Status

- Using 1989 as a base year: the 1987-89 highest 1-hour ozone design value in the Philadelphia Nonattainment Area was 0.187 ppm at Chester, Delaware County, Pennsylvania.

- The Philadelphia Nonattainment Area attainment year is 2005. At that time the design value must be less than or equal to 0.124 ppm.

- In order to meet the 2005 target, monitored values would need to reduce:

  2005-1989 = 16 yrs

  0.187-0.124 = 0.063 ppm

  0.063 ppm/16 yr = 0.00394 ppm/yr

- The goal (highest 1-hour ozone design value) for 2004 is:

  2004-1989 = 15 yrs

  0.00394 ppm/yr x 15 yrs = 0.0591 ppm (ozone improvement goal)

  0.187-0.0591 = 0.1279 ppm (ozone design value goal for 2004)

- Based on preliminary 2004 1-hour ozone data, the highest 1-hour ozone design value in the Philadelphia Nonattainment Area for 2004 is 0.129 ppm at Fairhills, Cecil County, Maryland.

- Thus, the Philadelphia Nonattainment Area would likely be closer to the 1-hour ozone standard had the NO_x SIP Call been implemented in the non-OTC states prior to May 31, 2004.

2.4.3 Conclusion

Substantial progress has been made in reducing emissions in New Jersey. Notwithstanding the need for further reductions in ozone precursors from sources upwind of New Jersey, the data presented for the Philadelphia Nonattainment Area demonstrate that the states are making great progress, in terms of controls on local sources, in reducing ozone precursor levels and ozone concentrations and exceedances in the region. In addition, the Philadelphia Nonattainment Area should realize substantial benefits from implementation of the NO_x Budget Program in the upwind non-OTC states in 2005. However, more progress will be needed to attain the 8-hour ozone standard.

3.0 New York Nonattainment Area

The New York Nonattainment Area is a multi-state nonattainment area that was defined shortly after enactment of the 1990 Clean Air Act Amendments Amendments and is comprised of twenty two full counties and two partial counties; two from Connecticut, twelve from New Jersey and ten from New York. Table 9 lists all the counties that are included in the New York Nonattainment Area. Figure 1 (Section 2.0) contains a map of the 1-hour ozone nonattainment areas with which New Jersey is associated.

Table 9. New York-Northern New Jersey 1-Hour Ozone Nonattainment Area

STATE	COUNTY
Connecticut	Fairfield - All cities and townships except Shelton City
	Litchfield - Bridgewater Town, New Milford Town
New Jersey	Bergen
	Essex
	Hudson
	Hunterdon
	Middlesex
	Monmouth
	Morris
	Ocean
	Passaic
	Somerset
	Sussex
	Union
New York	Bronx
	Kings
	Nassau
	New York
	Orange - Towns of Blooming Grove, Chester, Highlands, Monroe, Tuxedo, Warwick & Woodbury
	Queens
	Richmond
	Rockland
	Suffolk
	Westchester

3.1 Emissions Reduction Review

New Jersey has implemented statewide, all emission control programs mandated by the 1990 Clean Air Act Amendments as well as additional control measures needed to attain the 1-hour ozone standard. [25] Additional control measures are being adopted to address the ozone emission reduction shortfall identified by the USEPA.[26] All VOC emission reduction strategies required to address the shortfall have been adopted by New Jersey and those strategies have been submitted to the USEPA as revisions to the SIP (Table 10). The control measure to address oxides of nitrogen required by the USEPA shortfall analysis was proposed on September 20, 2004, the hearing held on October 28, 2004, and the comment period closed on November 19, 2004. Emission trends are summarized in the Trends Analysis section, 3.2.6, of this report.

Table 10. Recently Adopted Emission Reduction Strategies

Control Measure	Date of Adoption	Operative Date
Consumer Products	April 7, 2004	June 6, 2004
Portable Fuel Containers	April 7, 2004	June 6, 2004
Architectural & Industrial Maintenance Coatings	May 21, 2004	July 20, 2004
Mobile Equipment Refinishing	April 30, 2003	June 29, 2003
Solvent Cleaning Operations	April 30, 2003	June 29, 2003

In addition to implementing all mandated and shortfall control measures, the NJDEP has finalized a major consent decree with an electrical generator with facilities in Mercer and Hudson Counties. To meet the terms of this decree, the generator will install selective catalytic reduction or other Best Available Control Technology that would produce equivalent reductions at the 3 units. Some of these reductions will occur in 2004 and some by 2007.

New Jersey submitted a SIP Revision in 2003[27,28] which revised its 2005 and 2007 onroad motor vehicle emission budgets for the New Jersey portion of the Philadelphia Nonattainment Area and the New Jersey portion of the New York Nonattainment Area using the new MOBILE6 model. The ozone precursor onroad inventories based on MOBILE6 for the northern New Jersey counties were updated again in 2004.[29,30]

[25] State of New Jersey, *State Implementation Plan Revision for the Attainment and Maintenance of the 1-Hour Ozone National Ambient Air Quality Standard – Update to Meeting the Requirements of the Alternative Ozone Attainment Demonstration Policy: Additional Emission Reductions, Reasonably Available Control Measure Analysis,and Mid-Course Review*, 2001

[26] 67 FR 5152 (2002)

[27] State of New Jersey, *New Jersey Revised Motor Vehicle Emission Inventories and Transportation Conformity Budgets Using the MOBILE6 Model*, 2003

[28] 68 FR 43462 (2003)

[29] State of New Jersey, *New Jersey Revised Motor Vehicle Transportation Conformity Budgets Using the MOBILE6 Model*, 2004

[30] 69 FR 52834 (2004)

The MOBILE6 emission inventories showed increases in both the VOC and NO_x values relative to prior SIP budgets. The increases were due primarily to certain changes in the MOBILE model that updated our understanding of emissions from mobile sources. The model changes which contributed most significantly to the increases were likely the enhanced ability of the MOBILE model to account for emission increases due to vehicle acceleration and air conditioning. Although MOBILE5 accounted for the effects of vehicle acceleration by basing emissions on certain standard drive cycles, emission factors generated by MOBILE6 are based on drive cycles that are designed to more closely match real world driving conditions. In addition, the adjustments to emission factors due to air conditioning more accurately represent conditions than those factors in MOBILE5.

These SIP revisions showed that although the new levels of onroad motor vehicle emissions calculated using MOBILE6 are higher, the relative reductions in onroad emissions between the base year and the attainment year were found to be greater under the MOBILE6 model for the New Jersey portions of both the Philadelphia and New York Nonattainment Areas.

3.2 Trends analysis

Various data are analyzed for trends to determine the New York Nonattainment Area's and New Jersey's progress in attaining the 1-hour ozone NAAQS. The trends analyzed include: 1-hour ozone design values, monitor exceedances, air quality data, meteorology, emissions, population, labor and economic. Trends are analyzed from 1980 through 2004. This allows for a comparison of pre 1990 Clean Air Act Amendments conditions to post 1990 Clean Air Act Amendments conditions.

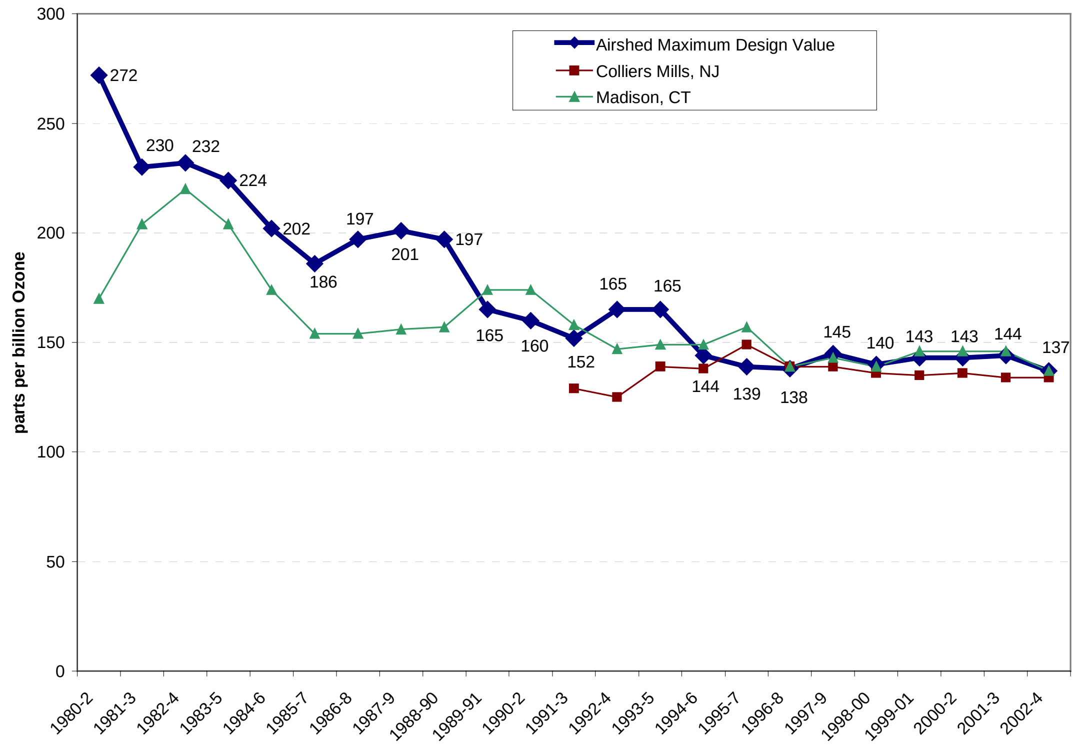
3.2.1 New York Nonattainment Area 1-Hour Ozone Design Values

Figure 14 displays the 1-hour ozone design value for the twenty four county New York Nonattainment Area from 1982 to 2004**.** This is the maximum monitor design value for all monitors within the New York Nonattainment Area. These design values do not include 1-hour ozone concentrations for some days in July, 2002 for monitors in the New Jersey and Connecticut portions of the New York Nonattainment Area. Many states in the northeast have flagged this data as an exceptional event due to the influence of the northern Quebec forest fires. Figure 3 (Section 2.2.1) contains a map of ozone monitoring sites in New Jersey.

One-hour ozone design values in the New York Nonattainment Area have declined substantially. Average design values from 1991-2004 have declined ~29% from average design values from 1980-1990 (pre 1990 Clean Air Act Amendments).

A trend line for Colliers Mills, New Jersey and Madison, Connecticut are also presented in Figure 14. The monitor at Colliers Mills is in Ocean County, New Jersey. Ocean County is part of the New York 1-hour ozone Nonattainment Area. The Colliers Mills monitor was not present at the time the 1-hour ozone nonattainment designations were made in 1990. The Colliers Mills site replaced a monitor located 6 miles away at McGuire Air Force Base in Burlington County. Burlington County is part of the Philadelphia 1-hour ozone Nonattainment Area. The Colliers Mills monitor reflects ozone values due to the Philadelphia area plume on more days that it reflects ozone values due to the New York area plume. The Colliers Mills data is presented here as indicative of upwind air quality.[31]

Figure 14. Design Values New York-Northern New Jersey 1-Hour Ozone Nonattainment Area 1982-2004



The monitor for Madison is in Middlesex County, Connecticut. Middlesex County is part of the Greater Connecticut Nonattainment Area. That monitor is located twenty four miles from Fairfield County which is part of the New York Nonattainment Area. Therefore, Madison data is included because of its proximity to the New York Nonattainment Area boundary.

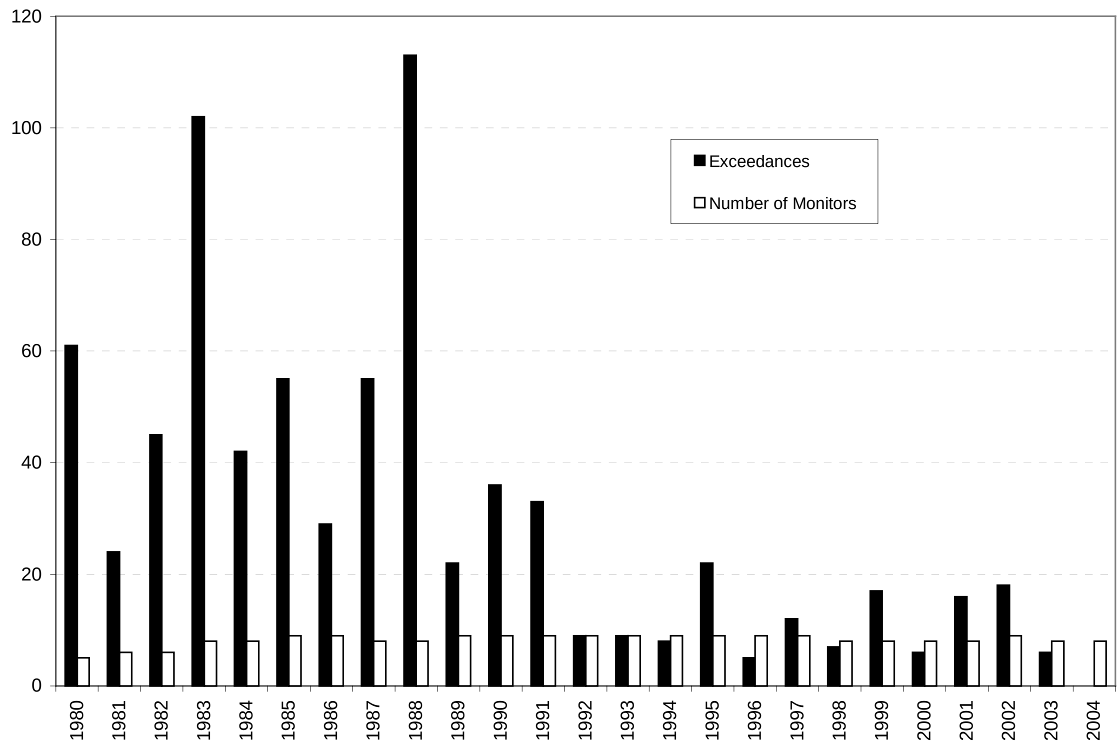
3.2.2 New Jersey Portion of the New York Nonattainment Area 1-Hour Ozone Monitor Exceedances

Trends in the total number of monitor exceedances in the New Jersey portion of the New York Nonattainment Area between 1980 and 2004 are shown in Figure 15. Monitor

[31] This design value does not include 1-hour ozone values for some days in July, 2002 due to the influence of Northern Quebec forest fires. If this data were included, the design value at Colliers Mills would be 0.145 ppm.

exceedances occur whenever a monitor's 1-hour ozone concentration is greater than or equal to 0.125 ppm.[32] There has been a dramatic decrease in the number of monitored exceedances since 1980. The average number of monitored exceedances from 1991-2004 declined ~71% from the average number of exceedances between 1980-90. This decrease cannot be attributed to a change in the number of monitors in the New Jersey portion of the New York Nonattainment Area since the number of ozone monitors has remained steady, with eight monitors operating in 1985 and 2004. (Note: there were five operating monitors in 1980.) There were no exceedances in 2004 in the New Jersey portion of the New York Nonattainment Area. This is the first time this has happened in the past two decades. In addition, New York and Connecticut only experienced one and two exceedances, respectively, of the 1-hour ozone standard in 2004.

Figure 15. Monitored Exceedances New Jersey Portion of the New York Nonattainment Area 1980-2004



3.2.3 New Jersey Monitor Trends

One-hour ozone trends were analyzed for five New Jersey ozone monitors within the New York Nonattainment Area. All five monitors operated during the 1980-2004-time period. Historically, there have been between five and nine ozone monitors operating in the twelve county New Jersey portion of the New York Nonattainment Area**.** Currently,

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32 As used here, monitor exceedance is the sum across the network of each monitor's individual number of exceedance days in a given year.

there are nine ozone monitors operating. Only two of the nine monitors currently operating in New Jersey's portion of the New York Nonattainment Area have design values that violate the 1-hour ozone standard. They are Colliers Mills in Ocean County (0.134 ppm) and Monmouth University in Monmouth County (0.128 ppm).[33] These 2004 values are close to the 2004 1-hour design value for the entire New York Nonattainment Area of 0.137 ppm at Greenwich, Connecticut, and Holtsville, New York. The design value for an entire nonattainment area is the monitor in the nonattainment area with the highest design value.

Table 11 lists current 1-hour ozone design values for all monitors in the twelve county New Jersey portion of the New York Nonattainment Area. Average design values for 1982-90, 1991-2004 and the percent change are also listed in the table. This cut-off was chosen to gauge the effects of emission controls imposed by the 1990 Clean Air Act Amendments. Design values have fallen ~14-25% from average pre 1990 Clean Air Act Amendments levels.

Table 11. 1-Hour Ozone Design Values in the Twelve County New Jersey Portion of the New York Nonattainment Area

Monitor	2004 Design Value* (ppm)	Average 1982-90 Design Value (ppm)	Average 1991-2004 Design Value (ppm)	% Change
Bayonne	0.108	0.166	0.125	-25%
Chester	0.118	0.149	0.122	-19%
McGuire & Colliers Mills[34]	0.134	0.158	0.136	-14%
Flemington	0.117	0.152	0.121	-20%
Newark[35]	0.114	0.145	0.114	-21%
Rutgers University[36]	0.122	0.178	0.134	-24%

* Preliminary

[33] This design value does not include 1-hour ozone values for some days in July, 2002 due to the influence of Northern Quebec forest fires. If this data were included, the design value at Colliers Mills would be 0.145 ppm.

[34] The Colliers Mills monitor replaced the McGuire monitor. These 2 monitors were approximately 6 miles apart. For this analysis the 1986-90 values at McGuire were used and the values 1991-04 at Colliers Mills were used. The 2004 design value is for Colliers Mills. This design value does not include 1-hour ozone values for some days in July, 2002 due to the influence of Northern Quebec forest fires. If this data were included, the design value at Colliers Mills would be 0.145 ppm.

[35] The Newark monitor has had many locations over the years but all have been within a 5 mile radius of each other. There are have been location problems with this monitor since 2000 and the last full data set recorded at the current site is for 2002.

[36] The Rutgers University monitor replaced the New Brunswick monitor. These 2 monitors were approximately 1 mile apart. For this analysis the 1980-94 values at New Brunswick were used and the 1995-2004 values at Rutgers University were used.

Table 12 lists the average number of 1-hour exceedances prior to and after enactment of the 1990 Clean Air Act Amendments. There have been significant reductions in the number of 1-hour exceedances for the six monitors in the twelve county New Jersey portion of the New York Nonattainment Area. Average 1-hour exceedances reductions range from ~71-94%.

Table 12. 1-Hour Ozone Exceedances in the Twelve County New Jersey Portion of the New York Nonattainment Area

Monitor	Average 1980-90 Exceedances (per year)	Average 1991-2004 Exceedances (per year)	% Change
Bayonne	7.5	1.6	-79%
Chester	6.1	0.8	-87%
McGuire & Colliers Mills[38]	9.7	2.8	-71%
Flemington	6.4	0.6	-91%
Newark[39]	4.5	0.3	-94%
Rutgers University[40]	7.4	1.8	-76%

Table 13 lists the changes in peak 1-hour ozone and 8-hour ozone values for the six monitors in the twelve county New Jersey portion of the New York Nonattainment Area that had continuous 1-hour measurements between 1980 and 2004 or continuous 8-hour measurements between 1986 and 2004. Post 1990 Clean Air Act Amendments average peak 1-hour ozone values have decreased ~15-28% compared to pre 1990 values. Post 1990 Clean Air Act Amendments average peak 8-hour ozone values have decreased by ~2-24% from pre 1990 values. (The 8-hour ozone standard is 0.080 ppm.)

Table 13. Peak 1-Hour and 8-Hour Ozone Concentrations in the Twelve County New Jersey Portion of the New York Nonattainment Area

	1-Hour Ozone Peak Values (ppm)			8-Hour Ozone Peak Values (ppm)		
Monitor	Yearly Average 1980-1990	Yearly Average 1991-2004	% Change	Yearly Average 1986-1990	Yearly Average 1991-2004	% Change
Bayonne	0.178	0.130	-27%	0.143	0.108	-24%
Chester	0.163	0.124	-24%	0.126	0.110	-13%
McGuire & Colliers Mills[38]	0.165	0.141	-15%	0.125	0.122	-2%
Flemington	0.156	0.123	-21%	0.124	0.107	-14%
Newark[39]	0.161	0.116	-28%	0.125	0.099	-21%
Rutgers University[40]	0.173	0.127	-27%	0.130	0.115	-12%

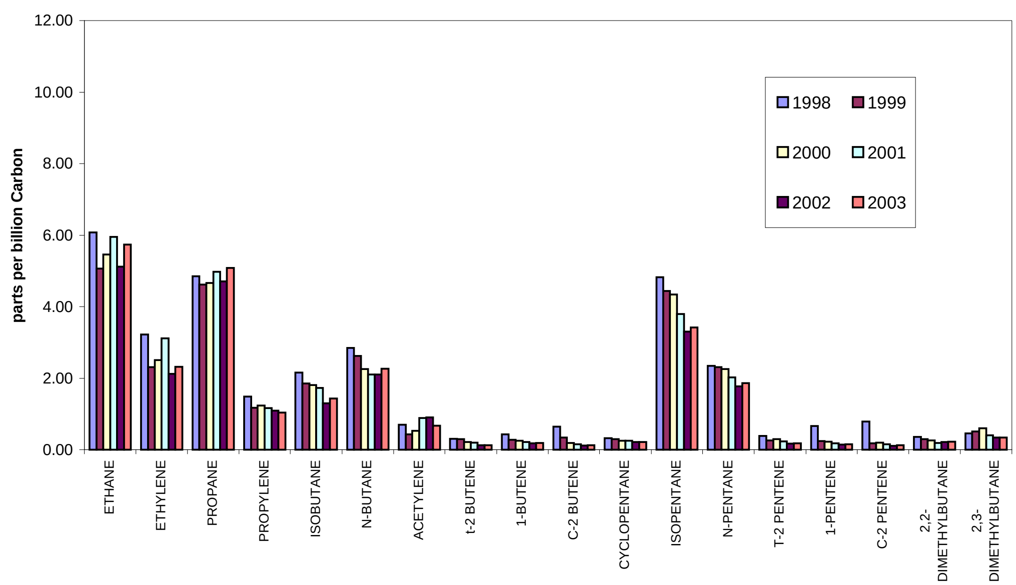
These declines are similar to reductions observed throughout the entire 1-hour ozone nonattainment area.

3.2.4 Other New Jersey Air Quality Trends

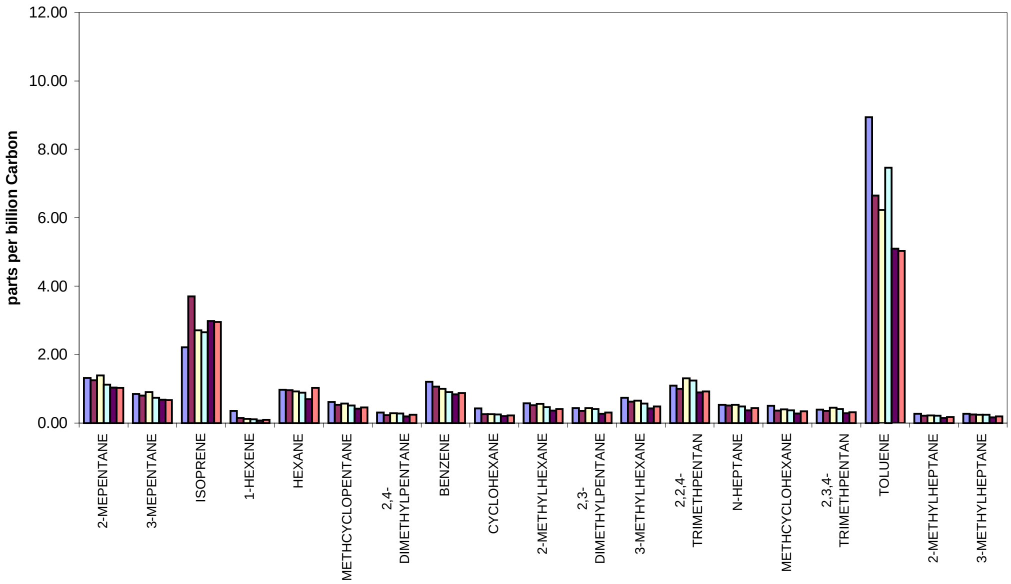
3.2.4.1 Volatile Organic Compounds

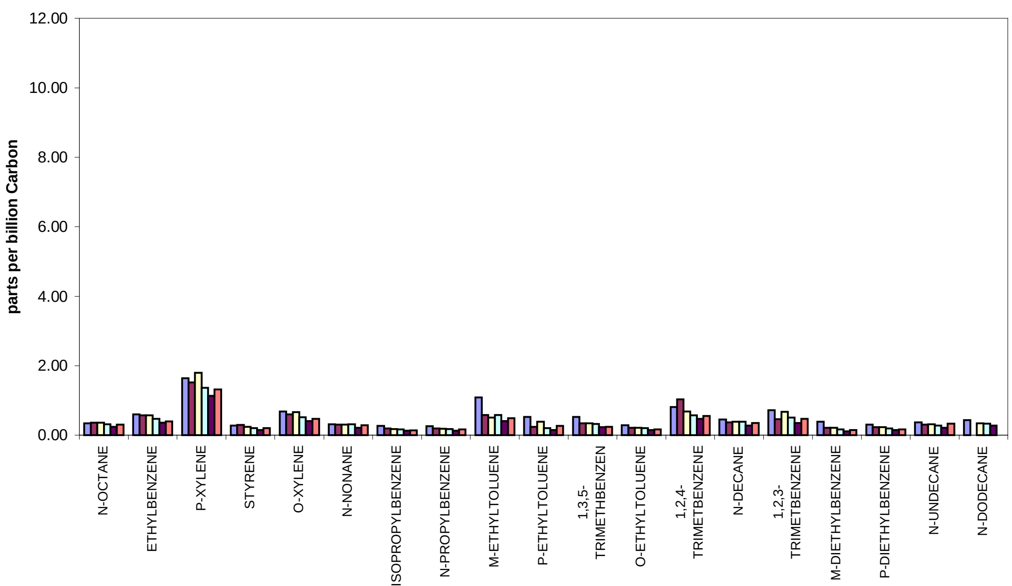
Ozone is formed when NO_x and VOCs react in the presence of sunlight. Federal revisions to air monitoring regulations required states to enhance monitoring for ozone and its precursors.[37] Some data for ambient concentrations of VOCs are gathered through the Photochemical Assessment Monitoring Stations (PAMS) program. The objectives of this program include providing a speciated ambient air database which is both representative and useful for ascertaining ambient profiles and distinguishing among various individual VOCs and which is characteristic of source emission impacts. Currently, only six years of speciated VOC data has been collected through the PAMS program. Although this is insufficient data to comment on the long term trends in this data, as shown in Figure 16, it appears that progress is being made in quantifying these compounds and some significant reductions are being recorded. A more detailed analysis of PAMS data in the New York airshed can be found in Appendix A.

Figure 16: Rutgers PAMS Summer Averages, 1998-2003



[37] 58 fr 8463 (1993)



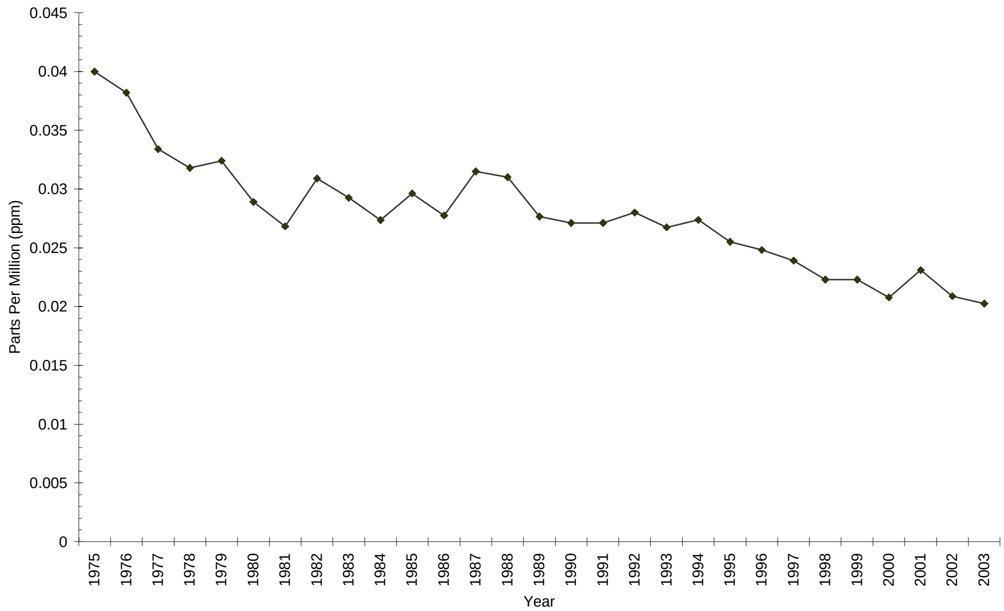


3.2.4.2 Nitrogen Dioxide

Nitrogen dioxide is a reddish-brown, highly reactive gas that is formed in the air through the oxidation of NO. NO_x is a mixture of gases comprised mostly of NO and NO_2. These gases are emitted from the exhaust of motor vehicles, the burning of coal, oil or natural gas, and during industrial processes such as welding, electroplating and dynamite blasting. Although most NO_x is emitted as NO, it is readily converted to NO_2 in the atmosphere. In the troposphere, near the Earth's surface, NO_2, not molecular oxygen, provides the primary source of the oxygen atoms required for ozone formation. New

Jersey monitored NO_2 and NO levels at eleven locations in 2003. As Figure 17 shows, NO_2 levels have decreased dramatically from 1975-2003. A more detailed analysis of NO_2 concentrations in the New York airshed can be found in Appendix B.

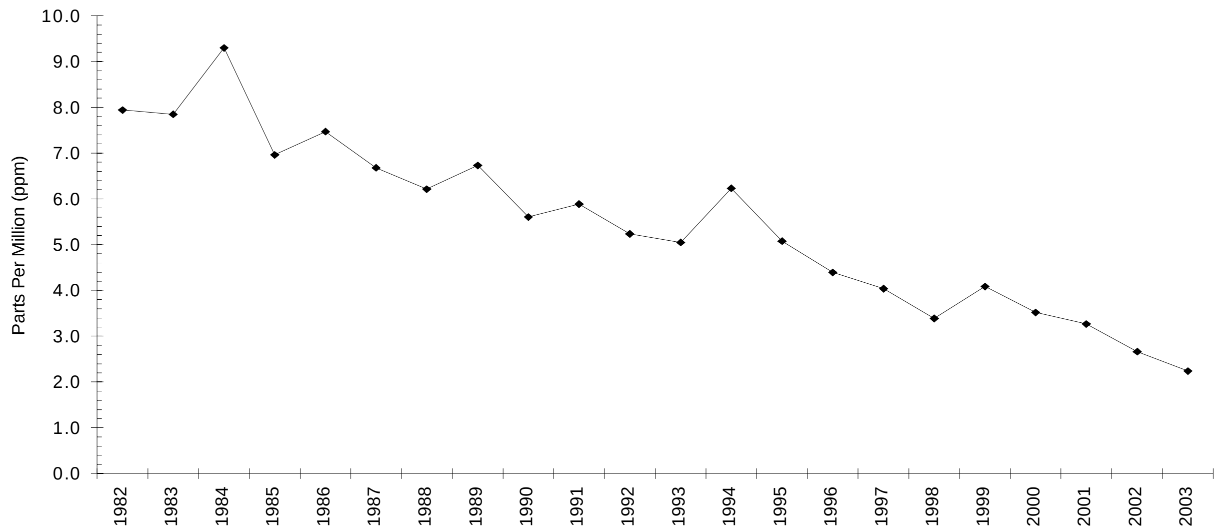
Figure 17. New Jersey Nitrogen Dioxide Air Quality, 1975-2003
Annual Average



3.2.4.3 Carbon Monoxide

Carbon monoxide is a by-product of mobile vehicle/equipment exhaust, industrial processes, fuel combustion in sources such as boilers and incinerators, and natural sources such as forest fires. CO is an ozone precursor produced as a result of incomplete combustion. The oxidation of the CO results in a net production of carbon dioxide and ozone. New Jersey monitored CO levels at thirteen locations in 2003. The NAAQSs for CO are 35 ppm for the 1-hour standard and 9 ppm for the 8-hour standard. The last time the CO NAAQSs were exceeded in New Jersey was January of 1995 and the entire state was officially declared as having attained the CO standard on August 23, 2002. As Figure 18 shows, CO levels has decreased dramatically from 1982 to 2003. A more detailed analysis of CO concentrations in the New York airshed can be found in Appendix B.

Figure 18. New Jersey Carbon Monoxide Air Quality, 1982-2003
2nd Highest 8-Hour Average



3.2.5 Meteorological Trends

As previously stated, ozone is not emitted directly to the atmosphere, but is formed by photochemical reactions between VOCs and NO_x in the presence of sunlight. The long, hot, humid days of summer are particularly conducive to ozone formation, and as such ozone levels are of general concern during the months of May through September. Correlations can be made between ozone concentrations and metrological variables such the number of 90º days, average temperature, precipitation and precipitation days. Hot dry summers usually produce long periods of elevated ozone concentrations while ozone production is usually limited to cool and wet summers.

Meteorological data from the New York City-Central Park weather station was reviewed to determine any trends between 1-hour ozone values and summertime weather conditions. Precipitation totals, the number of 90º days and precipitation frequency (number of days with measurable precipitation) have remained relatively unchanged between 1980 and 2004.

There have been a number of unusually warm summers during the 1980-2004 time period. These include 1983, 1988, 1991, 1995, and 2002. Table 14 lists meteorological data for these unusually warm years along with the average design values for the time periods encompassing the year. Examining design values and monitor exceedances from these warm summers indicate both values are declining over time.

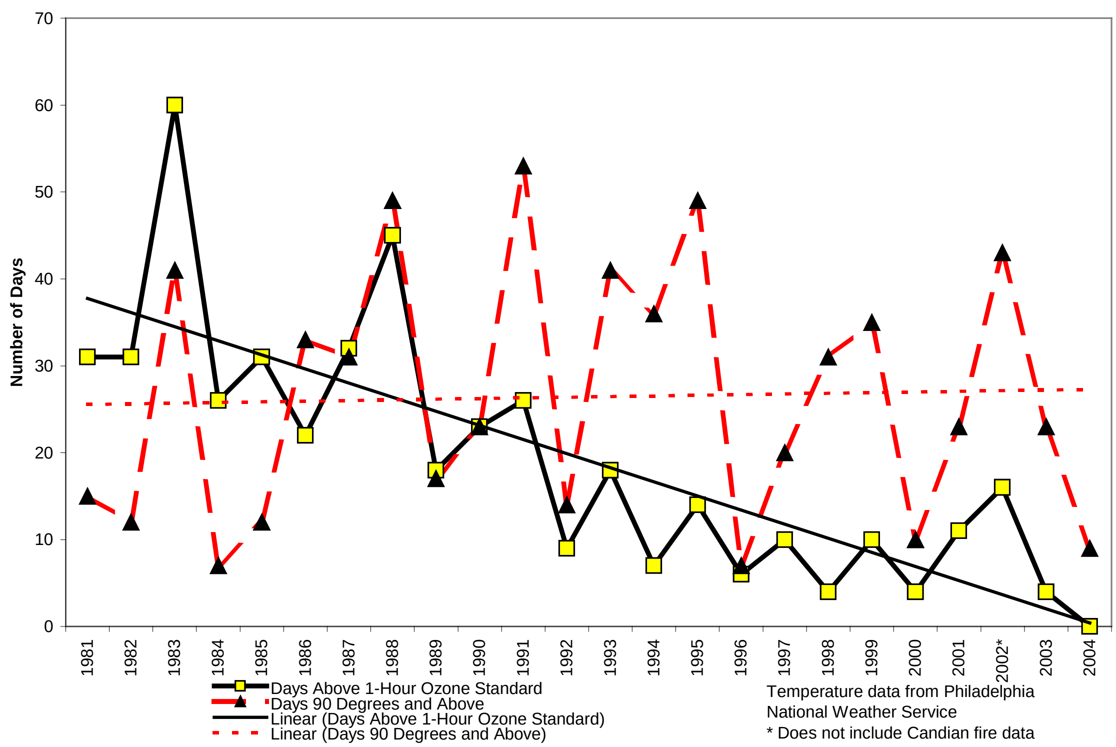
Table 14. Comparison of Warm Summers
New York City-Central Park*, 1982-2004

Year	90º Days	Precipitation (inches)	Measurable Precipitation days	Average Design Value** (ppm)
1983	29	13.48	22	0.229
1988	31	11.62	30	0.198
1991	31	15.86	35	0.159
1995	27	8.40	28	0.153
2002	27	10.44	25	0.141
Avg	29	11.96	28	

*Source: "Climatalogical Data", from the National Climatic Data Center (NOAA)
**Average for year included in the design value calculation. For example, for 1988, the average design value is the average of the 1986-8, 1987-9 and 1988-90 design values.

Trends between 1-hour ozone exceedances and summertime hot days (of 90° or greater) in New Jersey is shown in Figure 19. This shows that ozone exceedances are declining, while there is no significant trend in the occurrence of hot days, i.e. changing meteorology is not driving the ozone trend.

Figure 19. New Jersey 1-Hour Ozone "Unhealthy" Days vs. "Hot Days"



3.2.6 New Jersey Portion of the New York Nonattainment Area Emission Projections

Anthropogenic emissions[38] in the New Jersey portion of the New York Nonattainment Area are summarized in Table 15. There are significant projected reductions in ozone precursor emissions from local sources since the enactment of the 1990 Clean Air Act Amendments. NO_x and VOC emissions from the twelve county New Jersey portion of the New York Nonattainment Area are expected to decrease by ~45% between 1990 and 2007.

In addition, a series of control measures applicable to New Jersey sources adopted in 2003 and 2004 (see Section 3.1) will generate more emission reductions in the 2005 to 2007 timeframe. Recently adopted federal mobile control measures, such as onroad heavy duty diesel engine standards, nonroad diesel engine standards, and spark ignition Phase 2 engine standards, will start to phase in over the next several years and will generate substantial emission reductions.

Table 15. Emissions Rates from New Jersey Portion of New York Nonattainment Area Rate of Progress Report NO_x and VOC Emissions in Tons Per Day (TPD) Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Ocean, Passiac, Somerset, Sussex and Union Counties

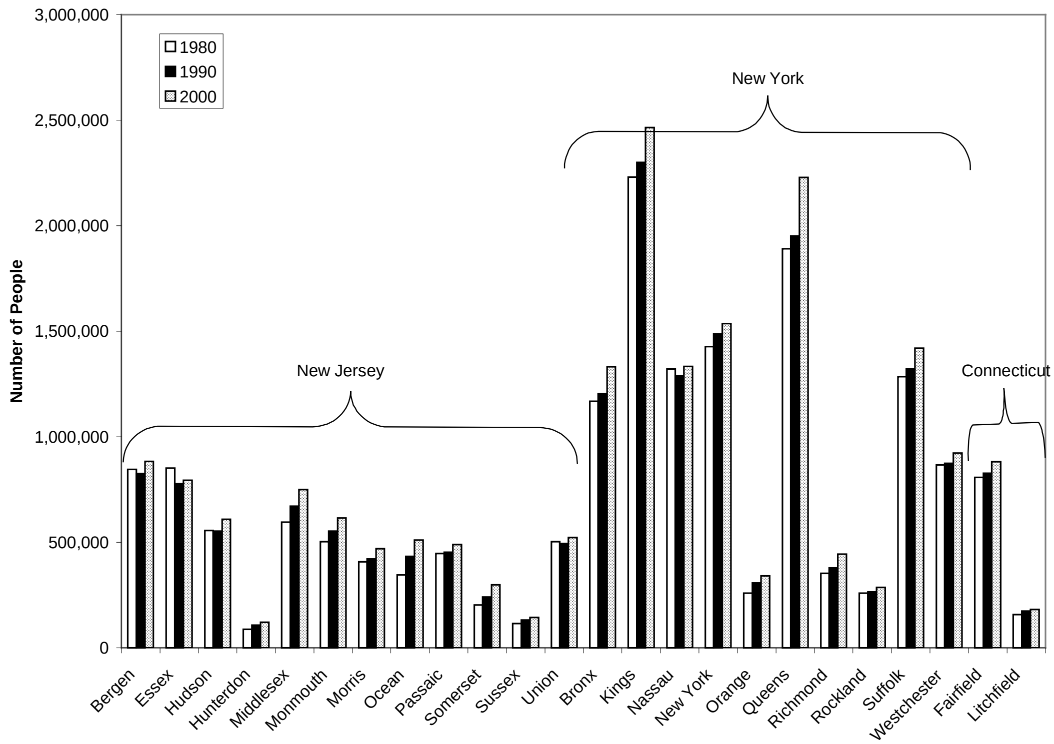
VOC		**NO_x**	
1990	**2007**	**1990**	**2007**
957 TPD	574 TPD	1012 TPD	502 TPD
% Reduction	40%	**% Reduction**	50%
Average % of Total VOC and NO_x Reduction		45%	

3.2.7 New York Nonattainment Area Population Trend

Census data for 1980, 1990 and 2000 were used to determine population trends within the New York Nonattainment Area. As shown in Figure 20, between 1980 and 2000 the twenty four counties that comprise the New York Nonattainment Area grew by ~12%, adding over two million people. Population growth was higher for seventeen of those counties in the 1990-2000 time frame than in the 1980-90 time frame. Emission reductions have occurred within the nonattainment area even though there have been significant increases in population.

[38] State of New Jersey, *State Implementation Plan Revision for Attainment and Maintenance of the Ozone National Ambient Air Quality Standard-New Jersey 1996 Actual Emission Inventory and Rate of Progress Plans for 2002, 2005 and 2007,* 2001

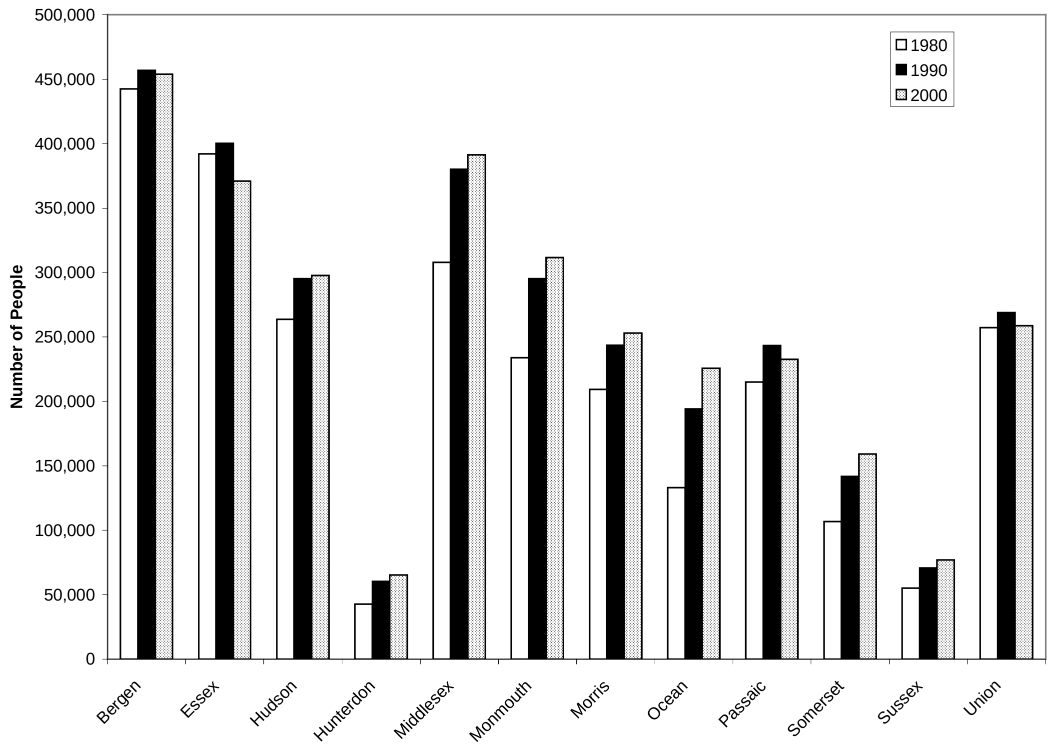
Figure 20. Population Trend
Twenty Four County New York 1 Hour Ozone Nonattainment Area



3.2.8 New Jersey Labor Force Trend

Estimates of the twelve county New Jersey portion of the New York Nonattainment Area's labor force, from the New Jersey Department of Labor, were examined to determine any trends. Figure 21 shows that the twelve county New Jersey area's estimated labor force has increased ~16% between 1980 and 2000. This increase is slightly larger than the 14% increase in population between 1980 and 2000. During the 1980-2000 time period the twelve county New Jersey area's population increased by over 744,000 people while the estimated labor force increased by ~437,000 people. Overall the population in the labor force has remained fairly constant, 49% in 1980 and 50% in 2000. Bergen, Hunterdon, Middlesex, Monmouth, Morris, Somerset and Sussex counties had over 50% of their populations in the labor force in 2000.

Figure 21. Estimated Labor Force
in Twelve County New Jersey Portion of the New York Nonattainment Area



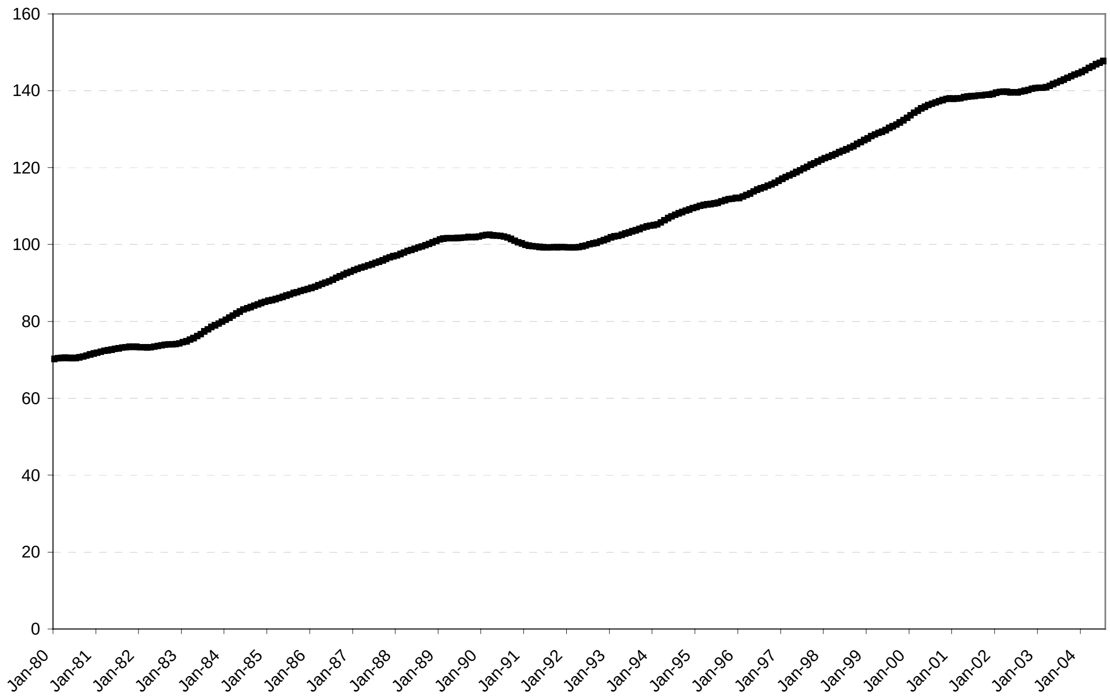
The bulk of the increase in the estimated labor force took place between 1980 and 1990 while the bulk of the population increase took place between 1990 and 2000. Economic indicators from the Philadelphia Federal Reserve (see Section 3.2.9) indicate New Jersey's economy expanded during each of these two decades. Labor force expansion during the 1980s, however, appears to be approximately nine times greater than what occurred during the 1990s. The effects of labor force changes in the twelve county New Jersey area on regional emissions are unknown. However, one could speculate that increases in the labor force might affect the total VMT in the region.

3.2.9 New Jersey Economic Indicator Trend

Economic indices compiled by the Philadelphia Federal Reserve Bank were examined to gauge New Jersey's economic activity. Emissions are undoubtedly tied to economic activity and would likely increase during periods of robust economic growth and stagnate during periods of recession. Figure 22 shows the economic activity index for New Jersey from 1980 through July 2004.

Periods of heightened economic activity in the State occurred during the late 80s and the late 1990s through the early 2000s. Economic growth slackened from 1991-94 and from 2002-03. Economic trends and their relationship to ozone concentration levels have generally not been examined.

Figure 22. New Jersey Economic Activity Index 1980 – July 2004



Data fom Philadelphia Federal Reserve Bank
http://www.phil.frb.org/econ/eai/

3.3 Ozone Transport Analysis

Ozone transport has a significant effect on ozone concentrations within the New York Nonattainment Area. This was clearly demonstrated in a recent study that was coincidentally conducted during the August 2003, blackout in the Midwest and northeast.[39] Airborne observations over central Pennsylvania on August 15, 2003, ~24 hours into the blackout, revealed large reductions in SO_2 (>90%), ozone (~50%) and light scattered particles (~70%) relative to measurements outside the blackout region and over the same location when power plants were operating normally. At the time of the blackout, reported SO_2 and NO_x emissions from upwind power plants were down to 34 and 20% of normal, respectively. Ozone decreased by ~0.038 ppm. This clean air benefit was realized over parts of the northeast.

A qualitative assessment is made on large-scale regional transport and transport via low-level jets into the New York Nonattainment Area. The results of that analysis are discussed in detail in the following.

[39] Marufu, L.T., et.al., "The 2003 North American Electrical Blackout: An accidental experiment in atmospheric chemistry", Geophysical Research Letters, 2004, v. 31

3.3.1 Regional Ozone Transport

The regional nature of ozone formation and transport has been recognized for some time.[40,41] On September 27, 1994, the OTC[42] agreed to develop a regional program to achieve significant reductions in NO_x emissions from large combustion sources. This program called for the establishment of a NO_x cap and trade program, and the establishment of an emissions cap or "budget" that all affected sources must not exceed during each control period, beginning in 1999. The program further called for a multi-phase approach to the budget calculation. The first phase essentially involved the NO_x Reasonably Available Control Technology requirements of the Clean Air Act Amendments for ozone nonattainment areas. The second phase was a budget cap commencing in 1999. A third phase was a more stringent cap that commenced in 2003.

In the late 1990s, the USEPA determined that NO_x emissions from sources and emitting activities in twenty three jurisdictions significantly contribute to the nonattainment of the 1-hour ozone NAAQS, or will contribute to the nonattainment of the 1-hour ozone NAAQS in one or more downwind states in the eastern portions of the United States.[43,44,45] The USEPA issued the NO_x SIP call requiring affected states to amend their SIPs and limit NO_x emission from May 1 to September 30 of each year starting in 2003.

Due to legal challenges the initial deadline for emission reductions under the NO_x SIP call was delayed until May 31, 2004. However, since the OTC states already had the OTC NO_x Budget Program in place, all the OTC states implemented the cap on May 1, 2003, except for New Hampshire which is not affected under the NO_x SIP call. A 2003 progress report on the NO_x Budget Program recently released by the USEPA states that the OTC states' ozone season NO_x emissions in 2003 from power plants and other large combustion sources were reduced by 30% from 2002 levels and were 18% less than the number of NO_x Budget Program allowances allocated in 2003.[46] In addition, NO_x highest daily emissions and average daily emissions in the OTC states have decreased ~25% and 35%, respectively, from 1997 to 2003.[47]

NO_x Budget Program states other than the OTC states did not commence caps until May 31, 2004. The USEPA 2003 report states that:

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[40] National Research Council, *Rethinking the Ozone Problem in Urban and Regional Air Pollution, National Academy Press*, 1991

[41] OTAG final report: http://www.USEPA.gov/ttn/rto/otag/finalrpt

[42] The Ozone Transport Commission includes the states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia and the District of Columbia

[43] 62 FR 60317 (1997)

[44] 63 FR 25902 (1998)

[45] 63 FR 57356 (1998)

[46] USEPA, *NOx Budget Trading Program-2003 Progress and Compliance Report*, EPA-430-R-04-010, 2004

[47] 1997 and 1998 data from Acid Rain Program; 1999-2002 data from OTC trading program; 2003 data from NBP

"A comparison of 2003 emissions with 2004 budgets demonstrates that some additional reductions will be necessary for these states to eventually reach their budgets."

The report further states that:

"Due to litigation, the 2004 control period for these states began on May 31, instead of May 1. The allowance allocations for 2004, however, are based on a full five-month ozone season. Because of the shorter control period in 2004 and CSP allowances distributed in 2004 to help sources comply with the program, [US]EPA anticipates that these states will have to achieve only modest reductions in 2004 to comply with the program. In 2005 and subsequent years, the control period will begin May 1, and deeper reductions will be necessary."

No update for 2004 has been issued on the implementation of the NO_x Budget Program in the non-OTC states. However, given the USEPA's statement that only modest reductions were needed in 2004 for these sources to comply with the NO_x Budget Program, it is unlikely that the OTC states saw much, if any, air quality benefit from the implementation of the NO_x Budget Program in the non-OTC states in 2004. Therefore, implementation of the NO_x Budget Program in the non-OTC states should only begin to provide substantial air quality benefits in the New York Nonattainment Area in 2005.

3.3.2 Ozone Transport Via Low-Level Jets

Ozone transport via low-level jets is a relatively recent discovery. Low-level jets are nocturnal phenomena that have the potential for moving large pools of ozone in the lower boundary layer. Low-level jets are similar to large-scale regional transport with ozone moving above the surface then mixing down to the surface shortly after sunrise. Many of the vertical wind profilers in the northeast have observed low-level jets during the summer.[48, 49]

Low-level jets form shortly after sunset when large-scale synoptic features are weak. Winds within these jets typically come from the south and may shift to the southwest towards daybreak. Wind speeds in the core of these jets can reach up to 15 m/s or nearly 35 mph. These jets have the potential of moving ozone laden air several hundred miles during the overnight hours. The nature of low-level jets makes it difficult to quantify their contribution to ozone transport into the New York Nonattainment Area.

[48] Verghese, S.J. et. al., "Characterization of Nocturnal Jets Over Philadelphia During Air Pollution Episodes", Proceedings of the American Meteorological Society 5th Conference on Atmospheric Chemistry, 2003

[49] Willitsford, A. et. al., "Development of an Air Pollution Event During the NEOPS-DEP 2002 Investigation", Proceedings of the American Meteorological Society 5th Conference on Atmospheric Chemistry, 2003

3.4 Summary and Conclusions

3.4.1 Trends Summary

- New Jersey has implemented all emission reductions required by the 1990 Clean Air Act Amendments, and all VOC reductions required under the USEPA's shortfall analysis. The control measure to address oxides of nitrogen required by the USEPA shortfall analysis was proposed on September 20, 2004, the hearing held on October 28, 2004, and the comment period closed on November 19, 2004.
- One-hour ozone design values in the New York Nonattainment Area have declined substantially. Average 1-hour ozone design values in the New York Nonattainment Area from 1991-2004 have declined ~29% from average design values from 1982-1990 (pre 1990 Clean Air Act Amendments).
- The average number of monitored exceedances in the New York Nonattainment Area from 1991-2004 declined ~71% from the average number of exceedances between 1980-90 (pre 1990 Clean Air Act Amendments).
- The New York Nonattainment Area's preliminary 2004 1-hour ozone design value is 0.137 ppm at Greenwich, Connecticut, and Holtsville, New York. The highest 1-hour ozone design value in the twelve county New Jersey portion of the New York Nonattainment Area is 0.134 ppm at Colliers Mills in Ocean County.[50] However, the monitor at Colliers Mills was not present at the time the 1-hour ozone nonattainment designations were made in 1990. A monitor was located six miles away at McGuire Air Force Base in Burlington County; Burlington County is part of the Philadelphia Nonattainment Area. The Colliers Mills monitor is therefore more likely responding to emissions from the Philadelphia Nonattainment Area. When the Collier's Mills monitor is excluded, the highest 1-hour design value in the remainder of the New Jersey portion of the New York Nonattainment Area is 0.128 ppm at Monmouth University in Monmouth County.
- Based on 2002, 2003 and preliminary 2004 1-hour ozone data, only two of the nine monitors in New Jersey's portion of the New York Nonattainment Area have design values which currently exceed the 1-hour ozone standard, Colliers Mills and Monmouth University.
- Average design values from 1991-2004 at five ozone monitors in the New Jersey portion of the New York Nonattainment Area have decreased ~14-25% from the average design value between 1980-90 (pre 1990 Clean Air Act Amendments).
- The average number of monitored exceedances from 1991-2004 for five monitors in the twelve county New Jersey portion of the New York Nonattainment Area have decreased ~71-94% from the average monitored exceedances between 1980-90 (pre 1990 Clean Air Act Amendments).
- Post 1990 Clean Air Act Amendments average peak values from 1991-2004 for five monitors in the twelve county New Jersey portion of the New York

[50] This design value does not include 1-hour ozone values for some days in July, 2002 due to the influence of Northern Quebec forest fires. If this data were included, the design value at Colliers Mills would be 0.145 ppm.

Nonattainment Area have decreased by ~15-28% from the average peak values from 1980-1990 (pre 1990 Clean Air Act Amendments).

- Dramatic decreases in ozone precursors, VOC, NO_2 and CO, have been documented.
- Ozone exceedances in New Jersey are declining while there is no significant trend in the occurrence of days of 90° or greater, i.e. changing meteorology is not driving the ozone trend.
- NO_x and VOC emissions from the twelve county New Jersey portion of the New York Nonattainment Area are estimated to decrease by ~45% between 1990 and 2007.
- Emission reductions have occurred and air quality has improved within the New York Nonattainment Area even though the population in the New York Nonattainment Area has increased by over two million people (~12%) and the twelve county New Jersey portion of the New York Nonattainment Area's estimated labor force has increased approximately 437,000 laborers (~16%) between 1980 and 2000.
- Regional transport into the New York Nonattainment Area was low during the 2004 ozone season.
- Post 1990 Clean Air Act Amendments average peak 8-hour ozone values in the New Jersey portion of the New York Nonattainment Area have decreased by ~2-24% from pre 1990 values.
- The New York Nonattainment Area continues to be impacted by regional transport.

3.4.2 New York Nonattainment Area 1-Hour Ozone Air Quality Status

- Using 1989 as a base year: the 1987-89 highest 1-hour ozone design value in the New York Nonattainment Area was 0.201 ppm at Stratford, Connecticut.

- The New York Nonattainment Area attainment year is 2007. At that time the design value must be less than or equal to 0.124 ppm

- In order to meet the 2007 target monitored values would need to reduce:

  2007-1989 = 18 yrs

  0.201-0.124 = 0.077 ppm

  0.077 ppm/18yr = 0.00428 ppm/yr

- The goal (highest 1-hour ozone design value) for 2004 is:

  2004-1989 = 15 yrs

  0.0428 ppm/yr x 15 yrs = 0.0642 ppm (ozone improvement goal)

  0.201-0.0642 = 0.1368 ppm (ozone design value goal for 2004)

- Based on preliminary 2004 1-hour ozone data, the highest 1-hour ozone design value in the New York Nonattainment Area for 2004 is 0.137 ppm at Greenwich, Connecticut, and Holtsville, New York.

- Thus, the New York Nonattainment Area is on target with the requirements of the 1-hour ozone standard. However, the impending reductions from implementation of the NO_x SIP Call in the non-OTC states as well as additional regional reductions are needed to assure that the New York Nonattainment area meets the requirements of the 8-hour zone standard.

3.4.3 Conclusion

Substantial progress has been made in reducing emissions in New Jersey. Notwithstanding the need for further reductions in ozone precursors from sources upwind of New Jersey, the data presented for the New York Nonattainment Area demonstrate that the states are making great progress, in terms of controls on local sources, in reducing ozone precursor levels and ozone concentrations and exceedances in the region. In addition, the New York Nonattainment Area should realize substantial benefits from implementation of the NO_x Budget Program in the upwind non-OTC states in 2005. However, more progress will be needed to attain the 8-hour ozone standard.

Appendix A

Analysis of Photochemical Assessment Monitoring Stations Volatile Organic Compound Data

Ozone is formed when oxides of nitrogen and volatile organic compounds (VOC) react in the presence of sunlight. Federal revisions to air monitoring regulations required states to enhance monitoring for ozone and its precursors.[51] Some data for ambient concentrations of VOCs are gathered through the Photochemical Assessment Monitoring Stations (PAMS) program. The Federal objectives of this program include providing a speciated ambient air database which is both representative and useful for ascertaining ambient profiles and distinguishing among various individual VOCs and which is characteristic of source emission impacts.

Following the PAMS network design, there are 3 locations within the New York Airshed that measure non-methane organic compounds (NMOCs). These locations are identified as upwind, center city and downwind. The three locations and their Aerometric Information Retrieval System (AIRS) designations are:

Location	AIRS ID	Status
New Brunswick, Rutgers, New Jersey	34-023-0011	upwind
New York Botanical Gardens, Bronx, New York	36-005-0083	center-city
Sherwood Island, Connecticut	09-001-9003	downwind

Although the PAMS network was to come on-line in 1995, the data acquisition, instrumentation, quality assurance issues and consistency of data were not necessarily fully synchronized until 1998, this analysis covers the period 1998 to 2003. Although this is insufficient data to comment on the long term trends in this data, it appears that progress is being made in quantifying these compounds and some significant reductions are being recorded. Prior analysis of some of the data from the above monitoring sites is available at the Northeast States for Coordinated Air Use Management website.[52]

Analysis

The purpose of this analysis is to examine changes in measured NMOCs at these three sites, with the intent to assess regulatory actions that have been undertaken to attain the 1-hour ozone national ambient air quality standard. In this analysis, the average concentrations of the fifty four compounds measured as part of the PAMS program are examined. Table 1 lists the PAMS compounds along with their AIRS code and no changes were made to these data. This analysis is based on data assembled from the USEPA Air Quality System for the summer months (June, July, August) for the period 1998 to 2003 and geometric average concentrations were computed only if there were

[51] 58 FR 8468 (1993)

[52] http://www.nescaum.org/projects/pams/index.html, Accessed on October 20, 2004

measurements for a minimum of ten days. Also, no data substitution was made in this analysis. All concentrations are in parts per billion of carbon.

Average (Geometric Mean) Concentrations

Since the PAMS data are collected hourly, it is of interest to examine the concentrations as a function of the time of the day. In this analysis, the concentrations at 6 AM and 1 PM, periods associated with the morning rush hour and well mixed atmospheric conditions, respectively, averaged over the summer months are examined. The data are displayed for the period of 1998 to 2003 for each of the three stations in Figures 1a through 3b. In general, the concentrations at both 6 AM and 1 PM are found to be higher at the Bronx, New York than at the other two locations, with the majority of compounds decreasing and a few exhibiting an increase over the study period of six years. In particular, only t-2-butene (43216), besides isoprene (43243), from biogenic sources, seems to exhibit higher concentrations at the downwind site (Sherwood Island, Connecticut) for both 6 AM and 1 PM and over the six year study period.

Figures 4, 5 and 6 display the hourly average of total NMOC (43102) concentrations for the three locations for the summer months from 1998 through 2003. Visual examination of the plots shows a decrease in concentrations during the mid-afternoon period with a peak around the morning rush hour of 6 to 8 AM. The concentration levels at the Bronx, New York site are higher than the other two sites over this time period. Also, there are year-to-year changes between the sites but, due to the limited data, no attempt was made to compute trends. However, it appears from the Figures 4 through 6 that hourly average (geometric mean) concentrations are higher in 2003 than in 2002 at New Brunswick, New Jersey and Bronx, New York but not at Sherwood Island, Connecticut. Further detailed analysis is warranted to establish any changes in the total NMOC levels.

Diurnal variation of selected species on a weekday / weekend basis

The diurnal variation in concentrations for selected species for a weekday and weekend was examined. Hourly concentrations were averaged for a weekday, represented by Wednesday, and a weekend day, represented by Saturday. The species selected for this analysis are listed below and discussed for each monitoring station.

Species	**AIRS ID**
Ethane	43202
Propane	43204
Isoprene	43243
Toluene	45202
M&P Xylene	45109
O-Xylene	45204
Benzene	45201

New Brunswick, New Jersey (AIRS ID 340230011)

Figures 7 through 13 display the weekday and weekend panels of hourly averaged concentrations for each of the species at New Brunswick, New Jersey. In the case of ethane (43202), the weekday and weekend patterns are quite similar with the morning rush hour peak occurring around 6 AM. Also, the maximum concentrations occur in the 4 to 6 AM period with absolute levels being slightly higher over the weekend. Visual examination of this hourly data provides no systematic trend. A similar pattern emerges for propane, with early morning hours associated with higher concentrations and lower concentrations associated with the afternoon hours.

However, in the case of isporene the above pattern does not hold. Isoprene emissions are biogenic in origin and are a function of ambient temperature linked with solar insolation and type of vegetation. Examination of the diurnal concentrations shows that at this location the concentrations tend to persist even after sunset when there are no known sources of emissions which would seem to indicate that there are other processes producing isoprene.

Figures 10, 11, 12 and 13 display the average hourly concentrations for toluene, m- and p-xylene, o-xylene, and benzene, respectively. All these species exhibit similar behavior of a 6 to 8 AM peak and weekend day concentrations being generally higher than the weekday concentrations.

New York Botanical Gardens, Bronx, New York (AIRS ID 360050083)

Figures 14 through 20 display hourly averaged concentrations of ethane, propane, isoprene, toluene, m- and p-xylene, o-xylene, and benzene, respectively for a weekday and weekend day. While the patterns are similar to those at the New Brunswick, New Jersey site, the absolute concentrations are generally higher. Also, the weekday pattern does not show a pronounced peak during the 6 to 8 AM period for most of these anthropogenic species, suggesting sources other than mobile sources may be influencing the monitor; on the weekend day those other sources are probably absent. Further analysis is needed on this aspect of the distribution of the anthropogenic species at this location.

Sherwood Island, Connecticut (AIRS ID 090010093)

Figures 21 through 27 display hourly averaged concentrations of ethane, propane, isoprene, toluene, m- and p-xylene, o-xylene, and benzene, respectively for a weekday and weekend day. While the diurnal patterns are similar to those at the New Brunswick, New Jersey and the Bronx, New York, the absolute concentrations are generally lower than those measured at the Bronx, New York.

Discussion and Summary

Although this is insufficient data to comment on the long term trends in this data, it appears that progress is being made in quantifying these compounds and some significant reductions are being recorded.

Overall it appears that the NMOC measurements at these three PAMS locations show a downward trend, except for a few species. These changes may be related to the changes in vehicular emissions as well as other sources. These results show that higher concentrations of species are often measured during the 6 to 8 AM period than at the 1 to 2 PM period when the atmosphere is well mixed. In general there appears to be an increase in the concentrations of ethane (43202) and propane (43204) which may be related to the increased use of natural gas in industrial and electric energy generation units. Also, the increase in ethane and propane concentrations may be linked to increases in the use of alternate fueled vehicles. The decrease in benzene concentrations can be attributed to the regulatory action related to reformulated gas composition.[53]

Only one species, t-2-butene, exhibits an increase at only the Sherwood Island, Connecticut location. t-2-butene is a component of volatile organic compound emissions arising from motor vehicles and is identified as one of the trigger compounds for issuing air pollution alerts.[54,55] It should be noted that the sites at the New York Botanical Gardens in the Bronx, New York and New Brunswick, New Jersey fail to exhibit higher concentrations or increases of t-2-butene during the six year period covered by this analysis.

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[53] Aleksic, N., G. Boynton and G. Sistla, "Concentrations and Trends of Benzene in Ambient Air over New York State During 1990 to 2002 (in preparation).

[54] http://www.sonomatechdata.com/sti_workbooks/Workbooks_PDF%5CPAMS_WKBK%5C08-Source_Apportionment.pdf Accessed on October 2004

[55] http://www.tnrcc.state.tx.us/updated/air/monops/airpollevents/2004/misc_bin/Glossary%20of%20terms_updated.htm, Accessed on October 2004

Table 1. PAMS Target Volatile Organic Compounds.*

Hydrocarbon	AIRS ID	Hydrocarbon	AIRS ID
Ethylene	43203	2,2,4-Trimethylpentane	43250
Acetylene	43206	n-Heptane	43232
Ethane	43202	Methylcyclohexane	43261
Propylene	43205	2,3,4-Trimethylpentane	43252
Propane	43204	Toluene	45202
Isobutane	43214	2-Methylheptane	43960
1-Butene[1]	43280	3-Methylheptane	43253
n-Butane	43212	n-Octane	43233
t-2-Butene	43216	Ethylbenzene	45203
c-2-Butene	43217	*m* & *p*-Xylene[2]	45109
Isopentane	43221	Styrene	45220
1-Pentene	43224	*o*-Xylene	45204
n-Pentane	43220	n-Nonane	43235
Isoprene	43243	Isopropylbenzene	45210
t-2-Pentene	43226	n-Propylbenzene	45209
c-2-Pentene	43227	*m*-Ethyltoluene	45212
2,2-Dimethylbutane	43244	*p*-Ethyltoluene	45213
Cyclopentane	43242	1,3,5-Trimethylbenzene	45207
2,3-Dimethylbutane	43284	*o*-Ethyltoluene	45211
2-Methylpentane	43285	1,2,4-Trimethylbenzene	45208
3-Methylpentane	43230	n-Decane	43238
n-Hexane	43231	1,2,3-Trimethylbenzene	45225
Methylcyclopentane	43262	*m*-Diethylbenzene[3]	45218
2,4-Dimethylpentane	43247	*p*-Diethylbenzene	45219
Benzene	45201	n-Undecane	43954
Cyclohexane	43248		
2-Methylhexane	43263		
2,3-Dimethylpentane	43291		
3-Methylhexane	43249		

* adapted from http://www.epa.gov/ttn/amtic/files/ambient/pams/pams54.pdf

[1] Note: because 1-butene and isobutene elute at about the same time, they are difficult to resolve. The coeluting isomers are assigned AIRS Parameter Code 43127. Isobutene is assigned AIRS Parameter Code 43270.
[2] The isomers of xylene are also difficult to resolve. Individually, their AIRS Parameter Codes are 45205 & 45206, respectively.
[3] Also named 1,3-Diethylbenzene.

Figure 1a

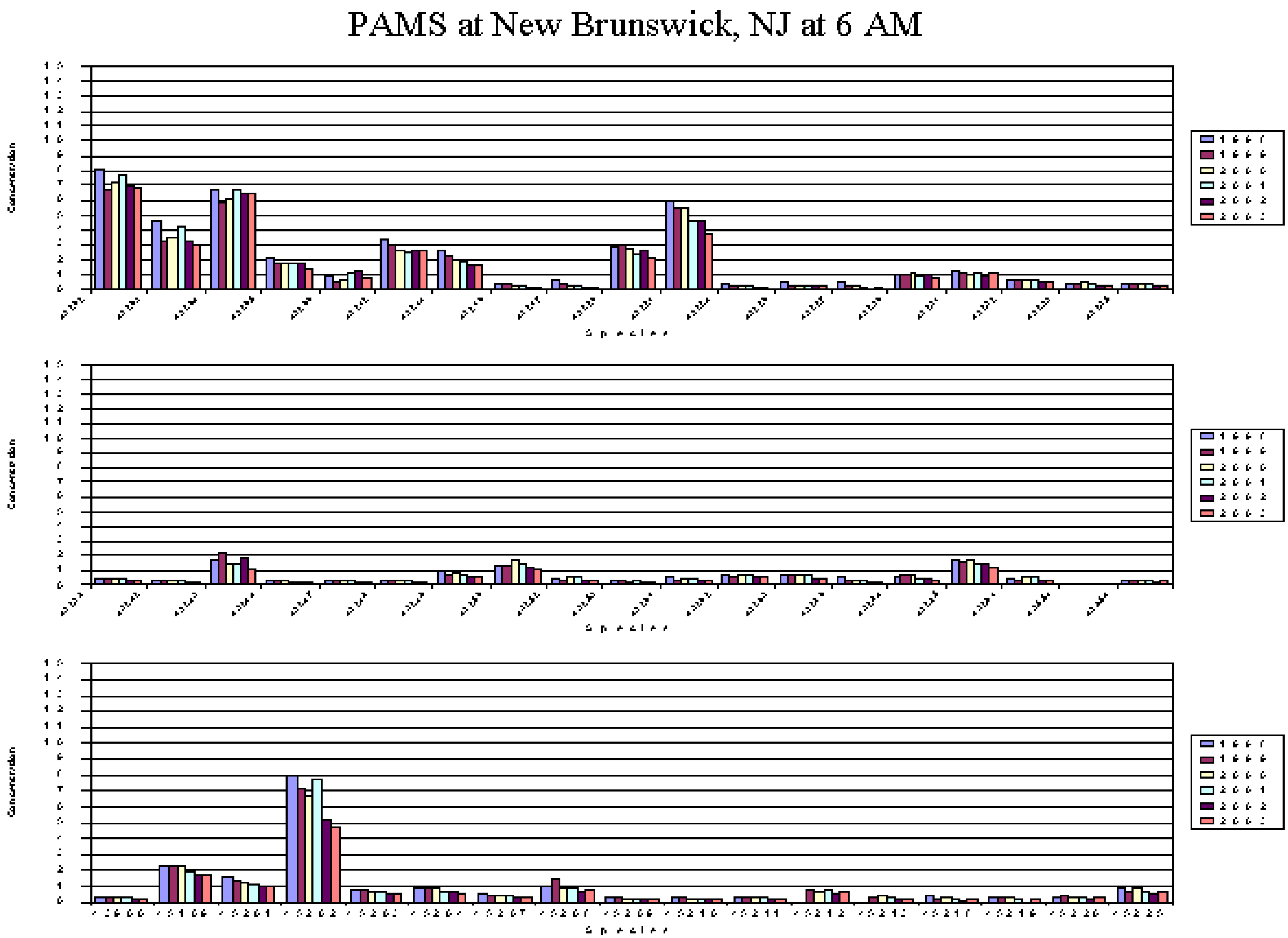


Figure 1b.

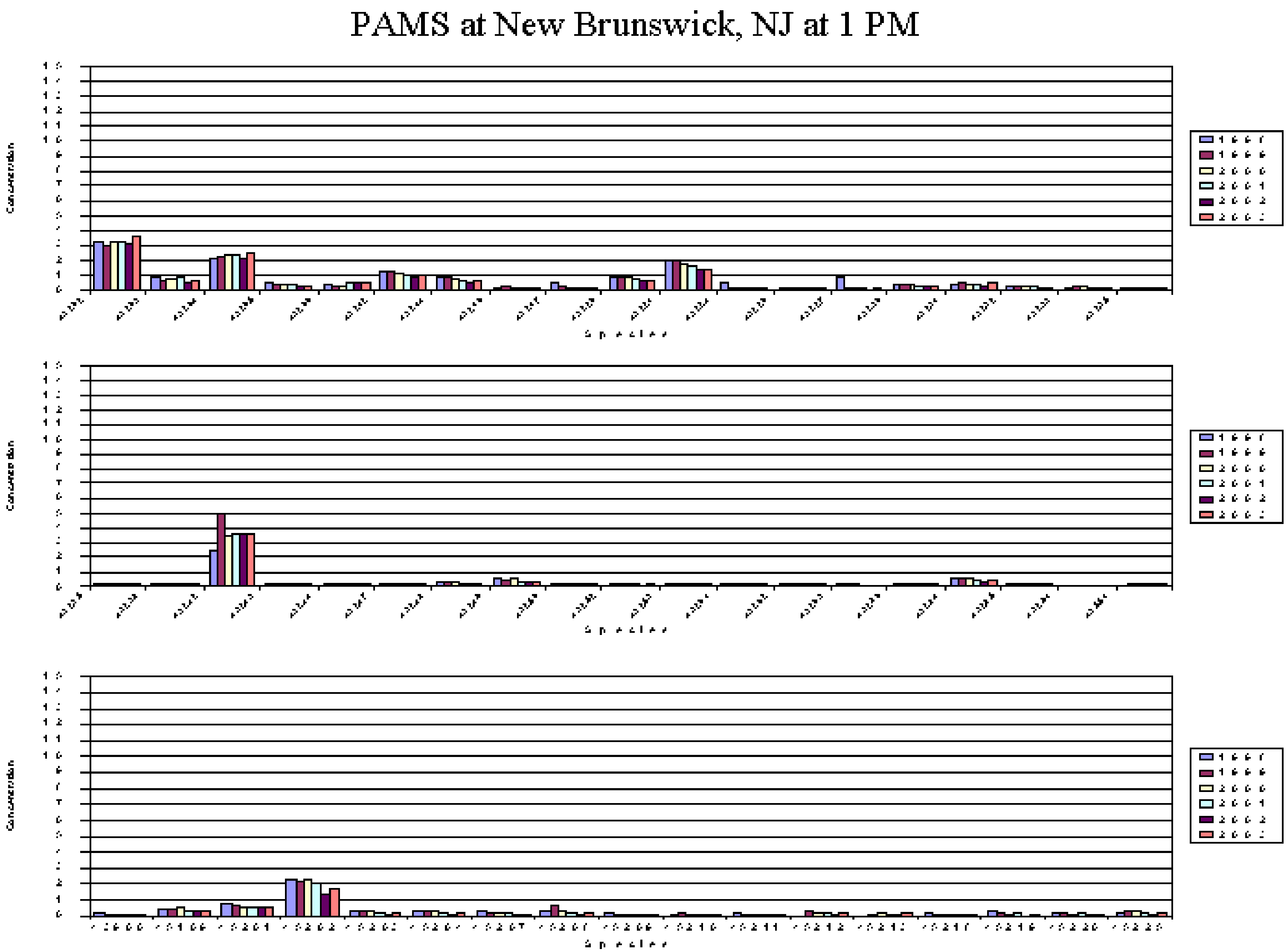

PAMS at New Brunswick, NJ at 1 PM
Concentration
Species
Concentration
Species
Concentration
Species

Figure 2a.

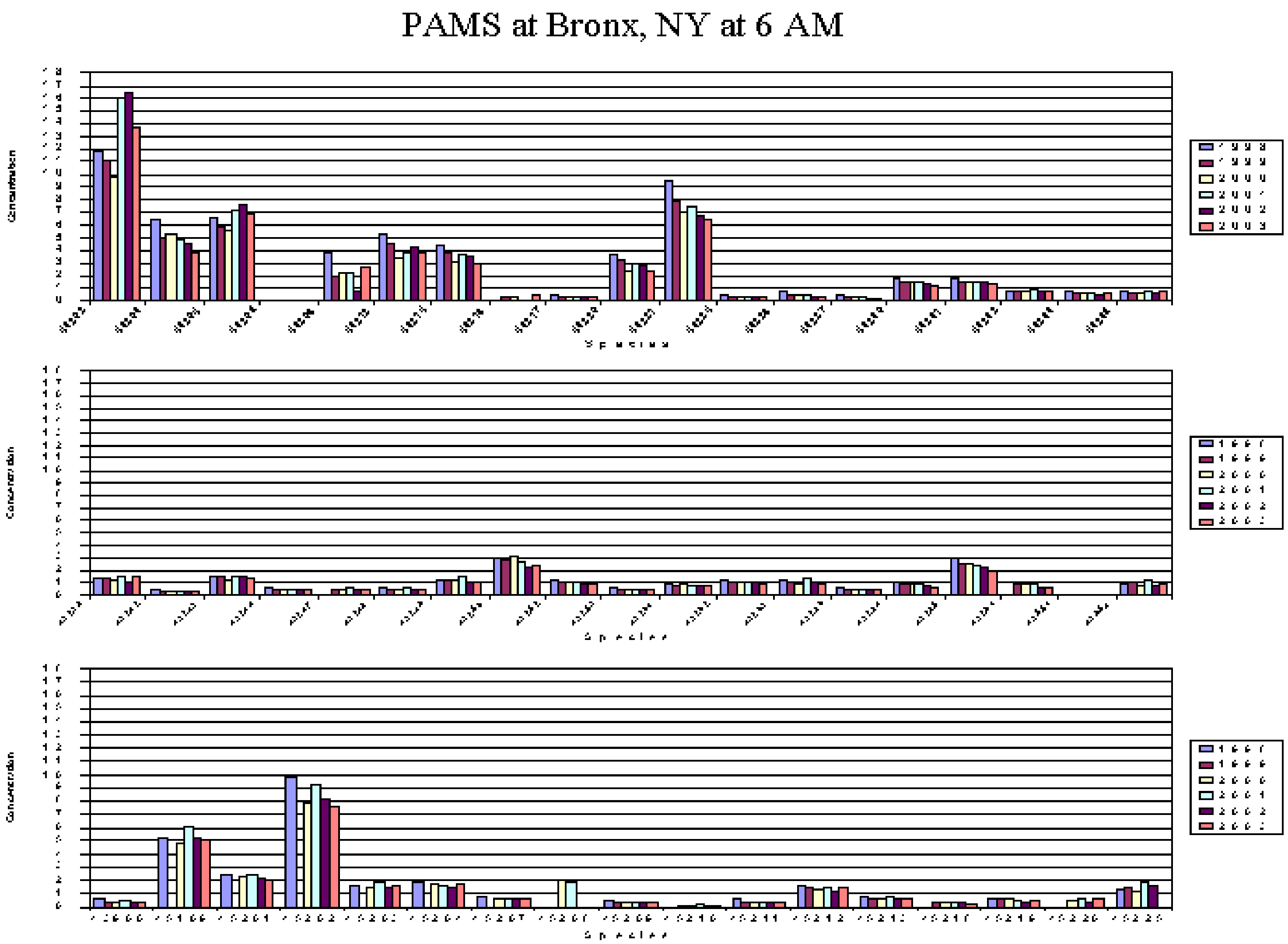


Figure 2b.

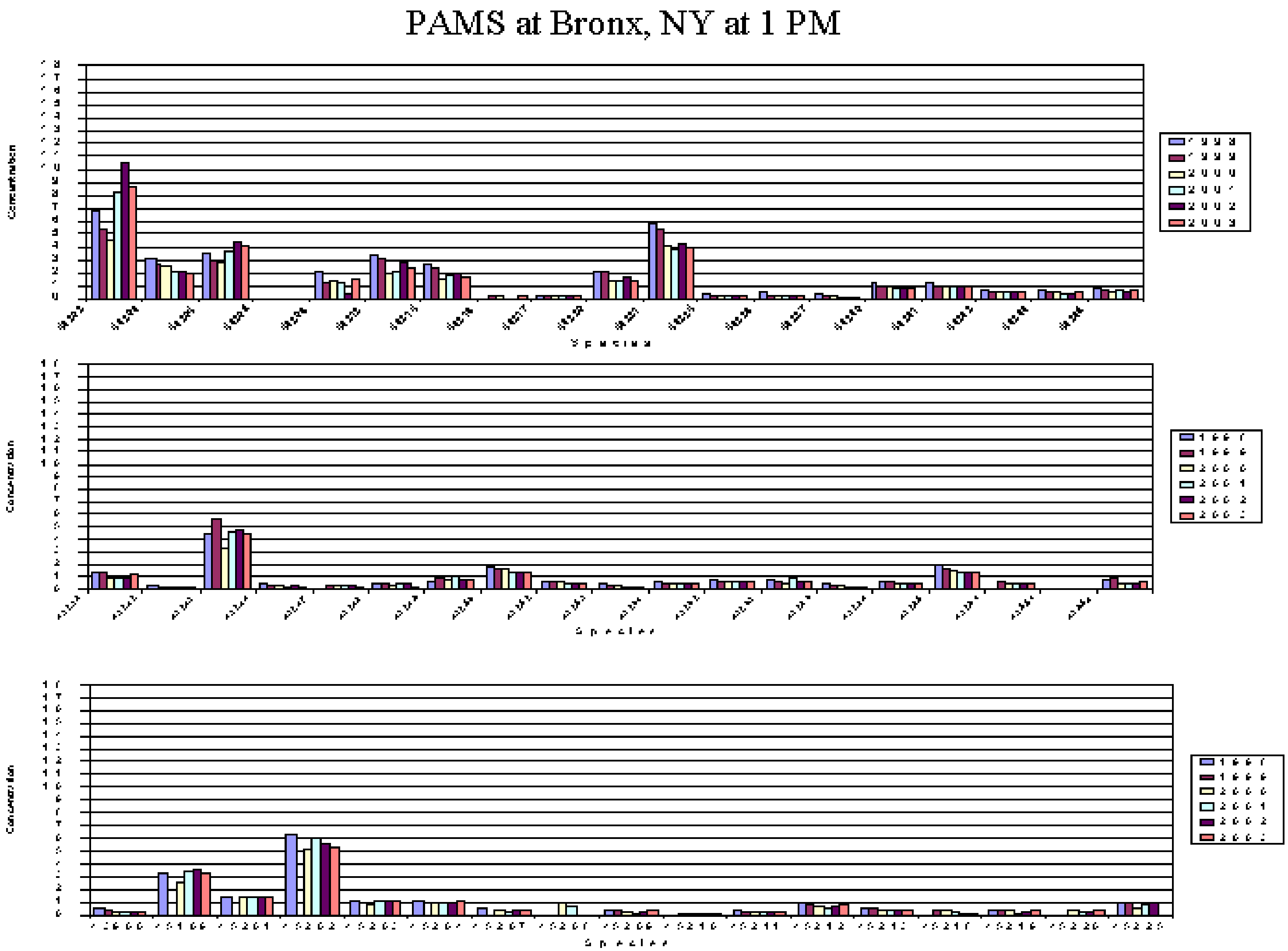


Figure 3a.

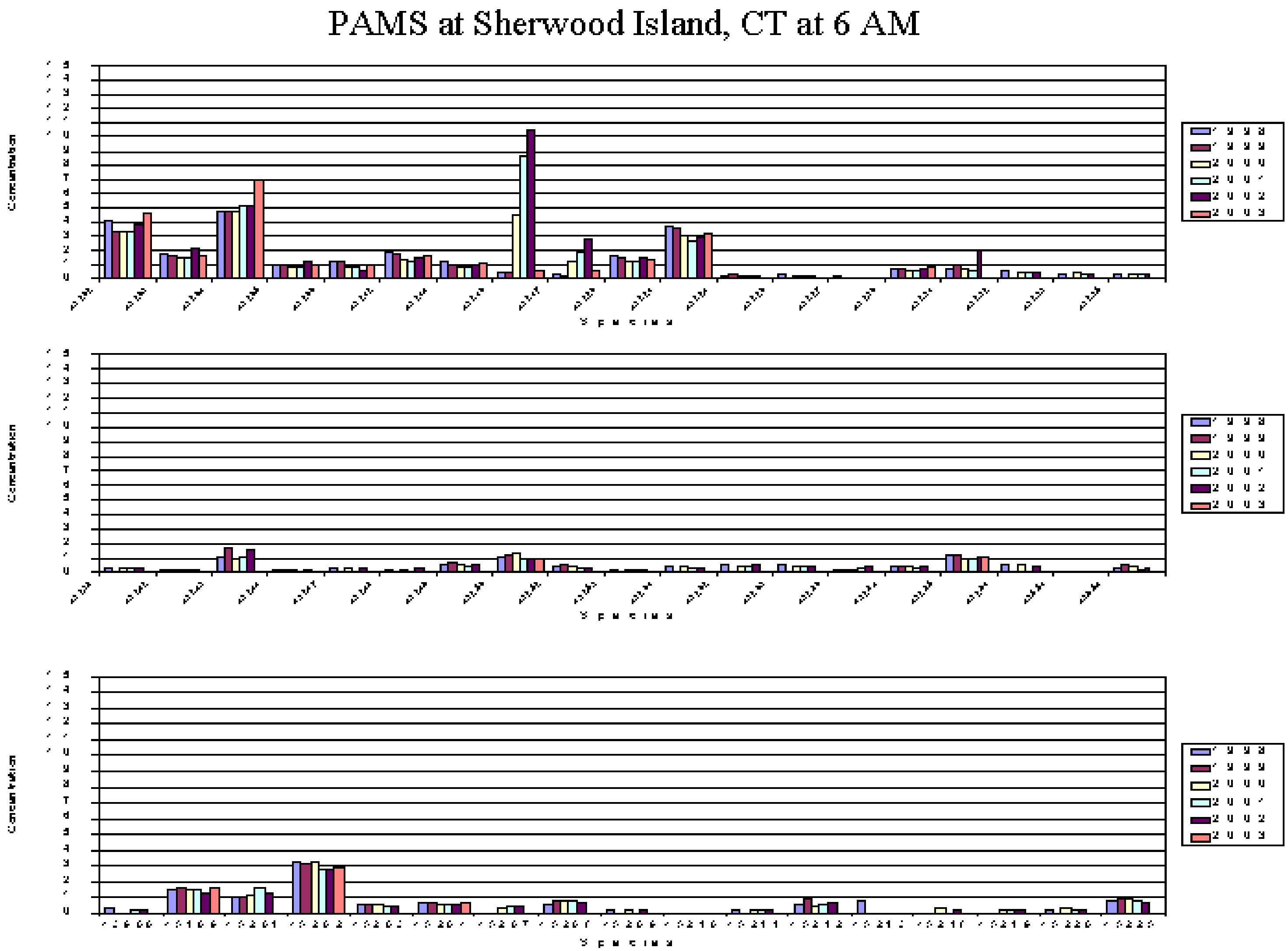


Figure 3b.

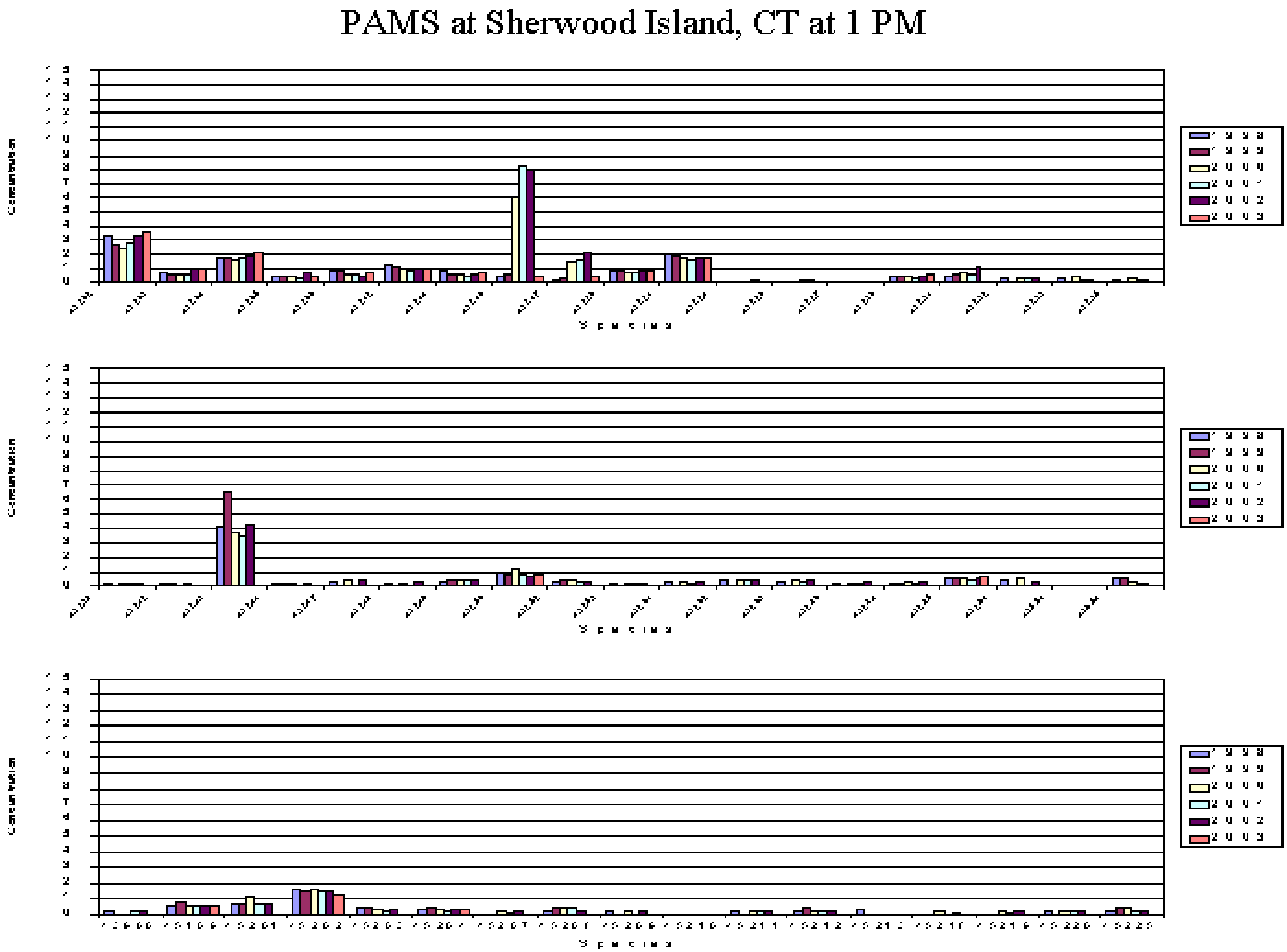


Figure 4.

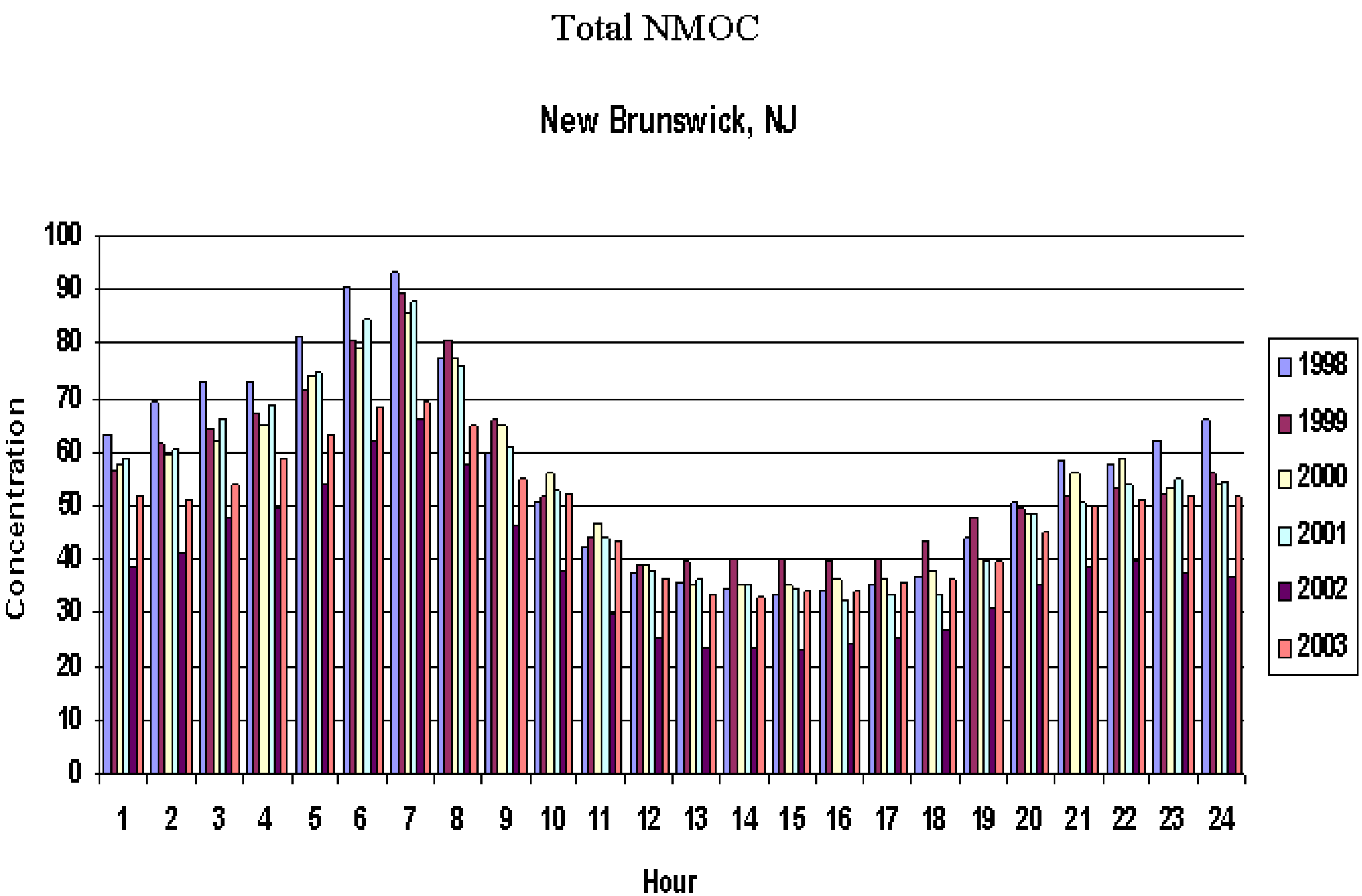

Total NMOC
New Brunswick, NJ
100
90
80
70
60
50
40
30
20
10
0
Concentration
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Hour
1998
1999
2000
2001
2002
2003

Figure 5.

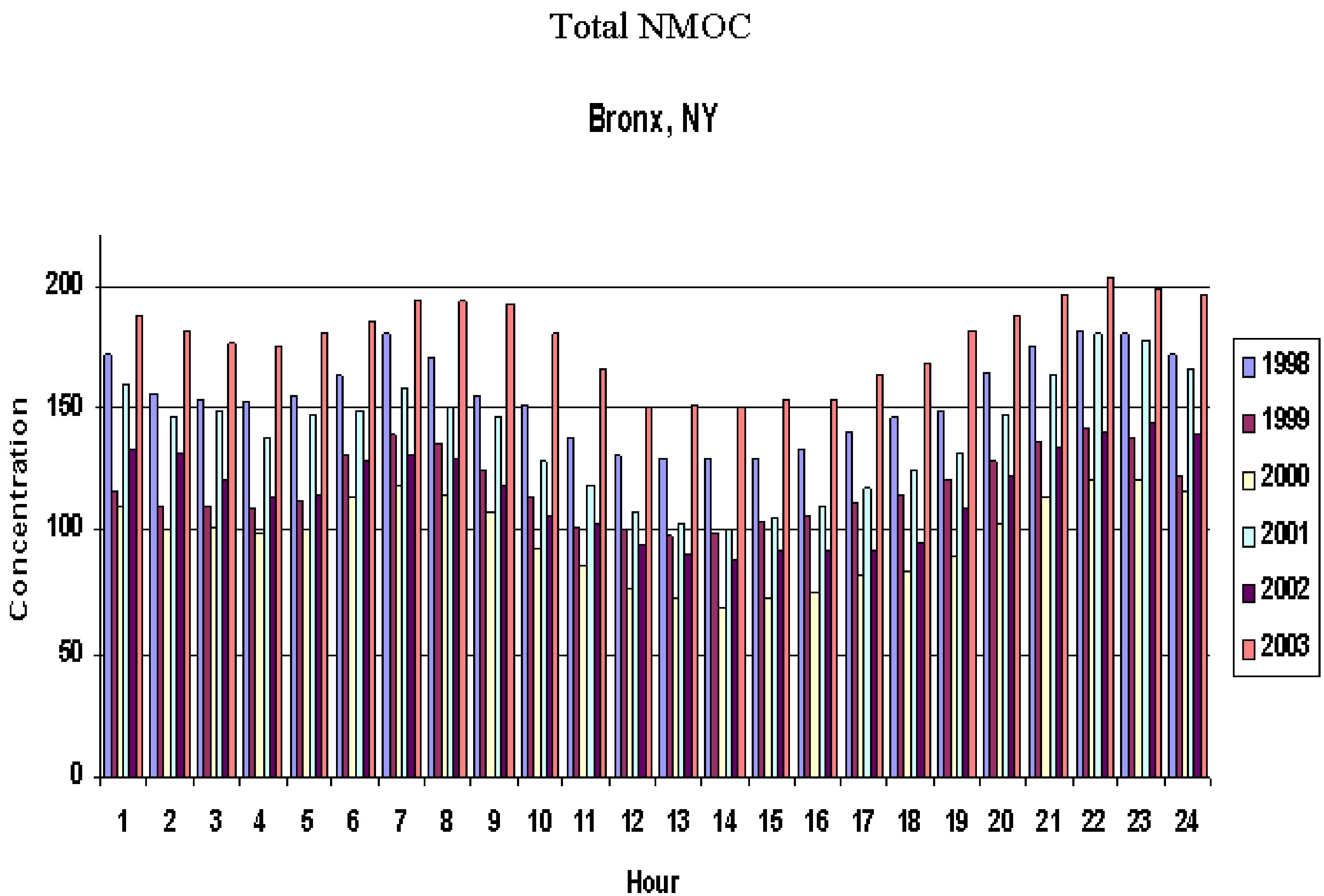

Total NMOC
Bronx, NY
200
150
100
50
0
Concentration
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Hour
1998
1999
2000
2001
2002
2003

Figure 6.

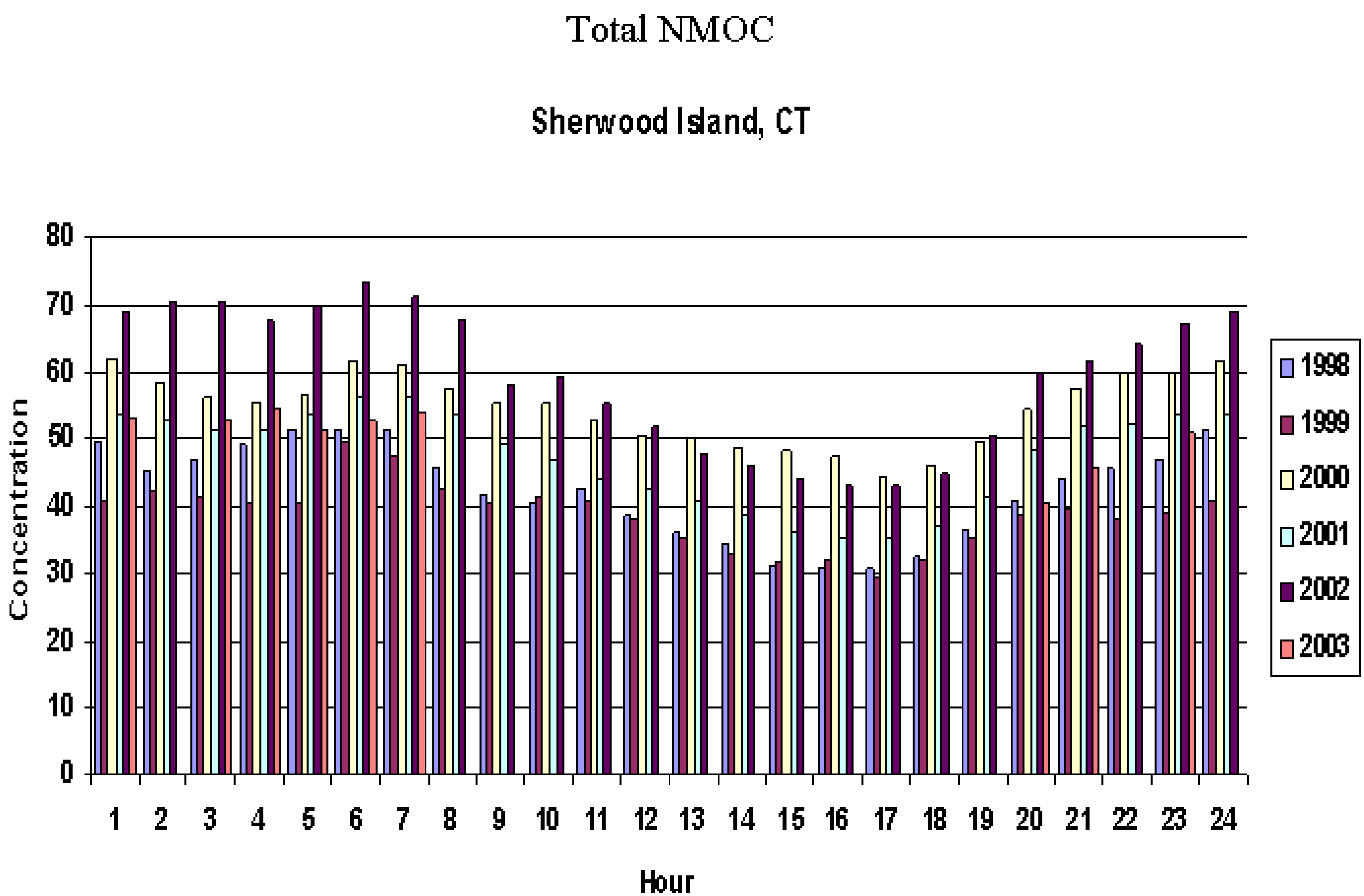
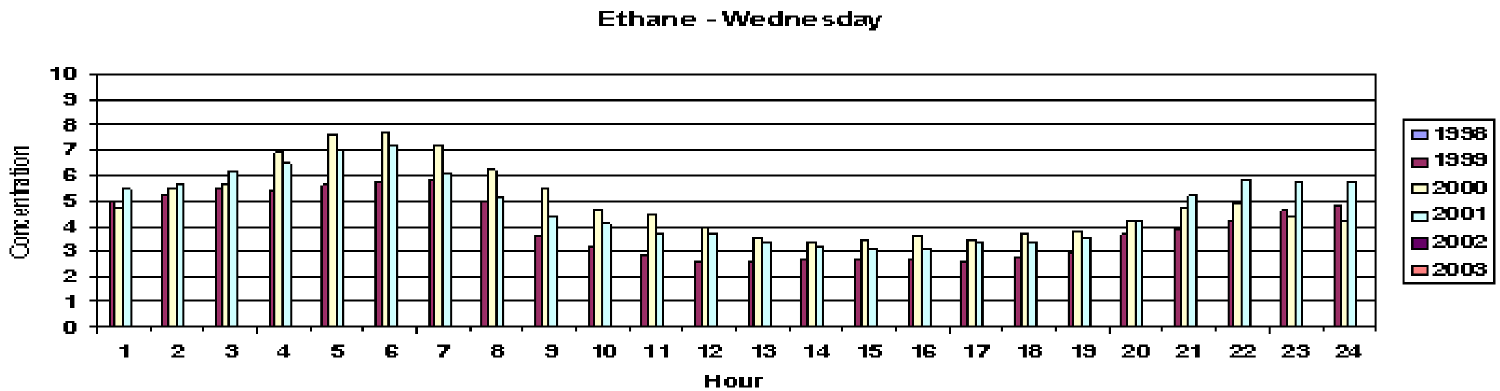

Total NMOC
Sherwood Island, CT
80
70
60
50
40
30
20
10
0
Concentration
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Hour
1998
1999
2000
2001
2002
2003

Figure 7.

Ethane (43202) diurnal variation: New Brunswick, NJ



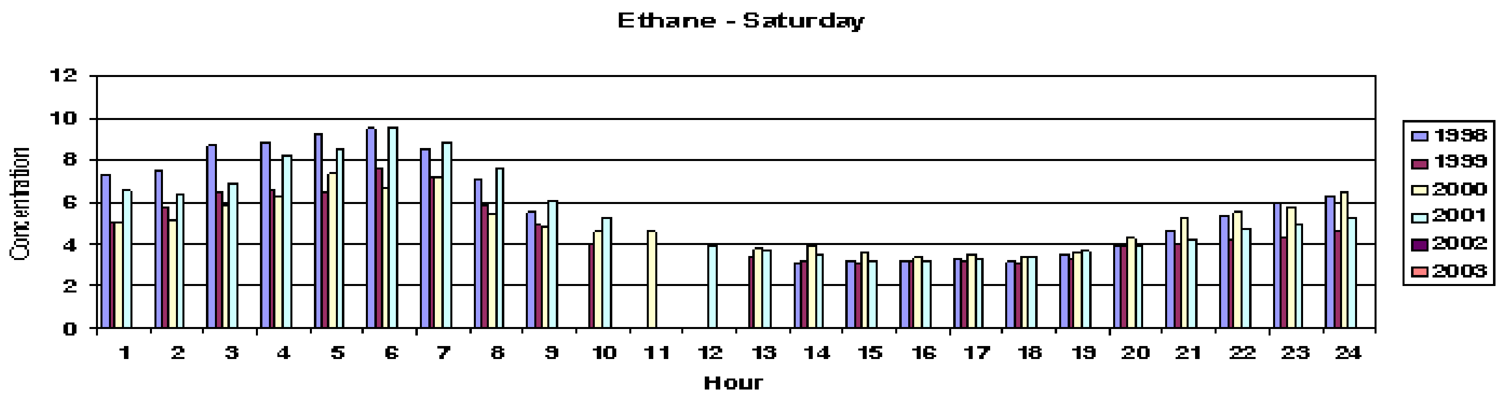
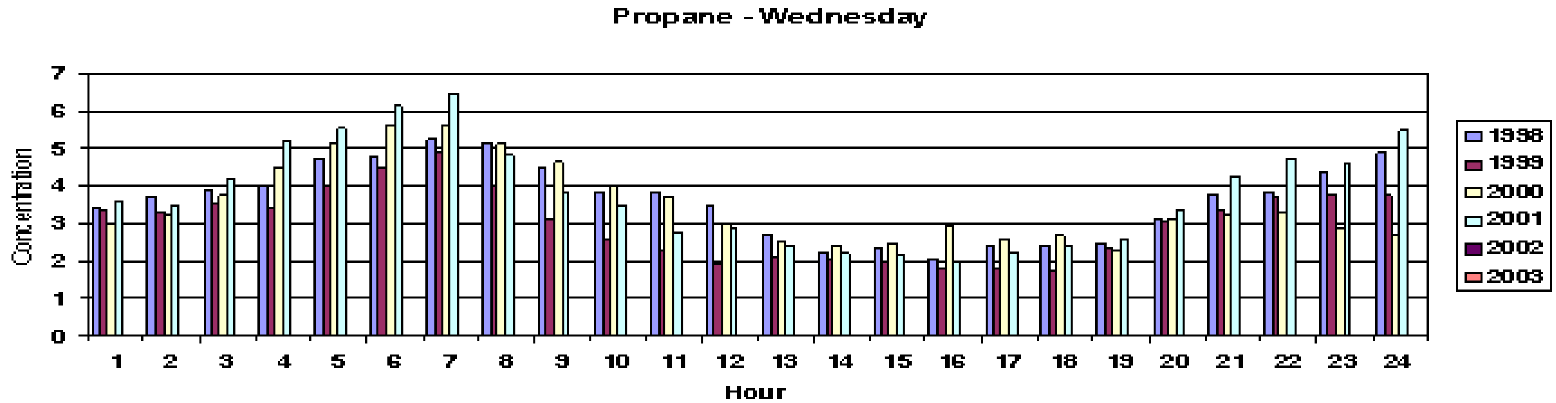


Figure 8.

Propane (43204) diurnal variation: New Brunswick, NJ



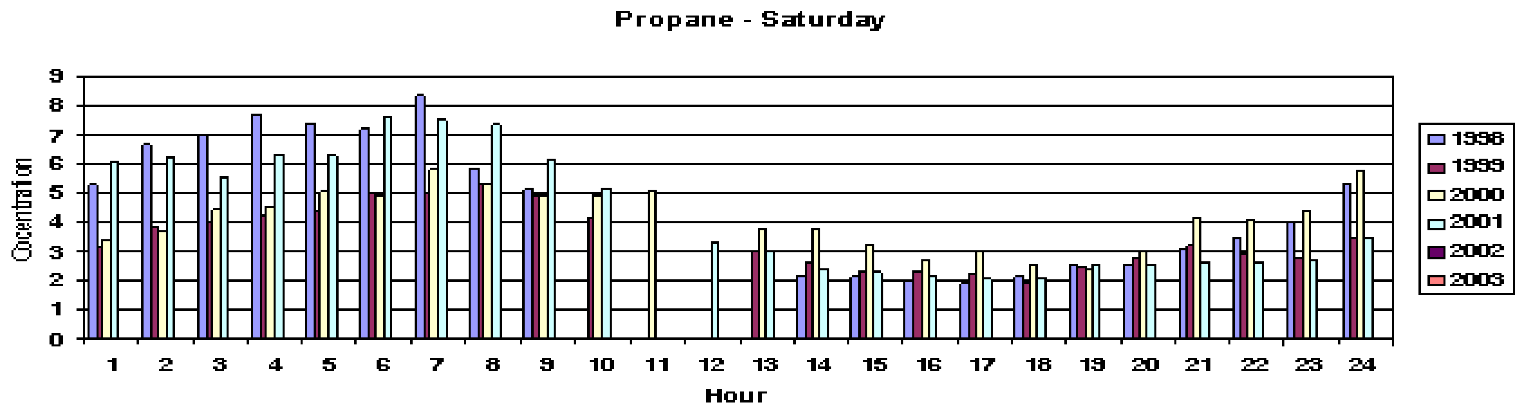
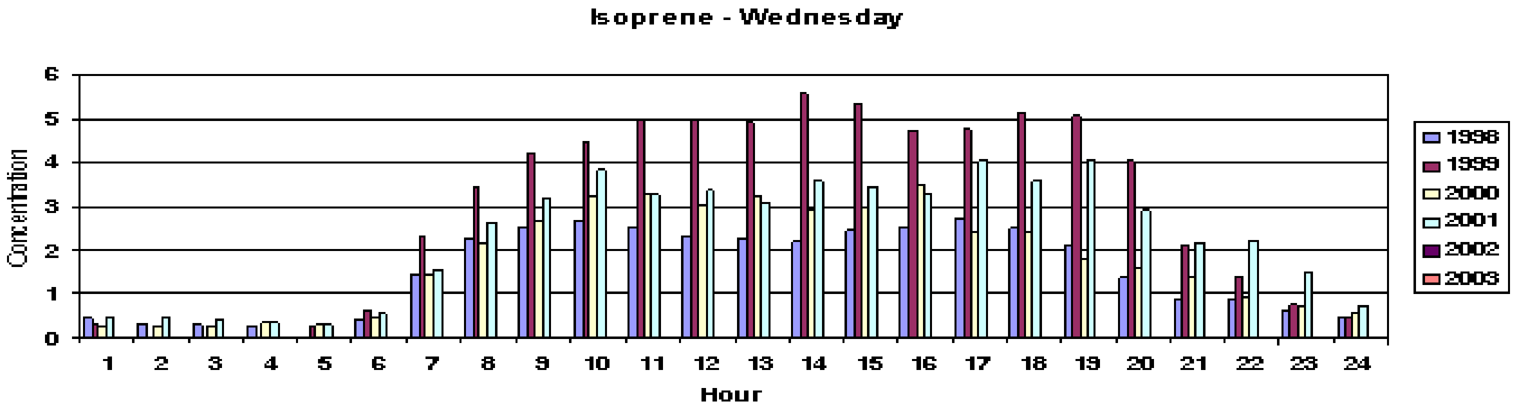


Figure 9.

Isoprene (43243) diurnal variation: New Brunswick, NJ



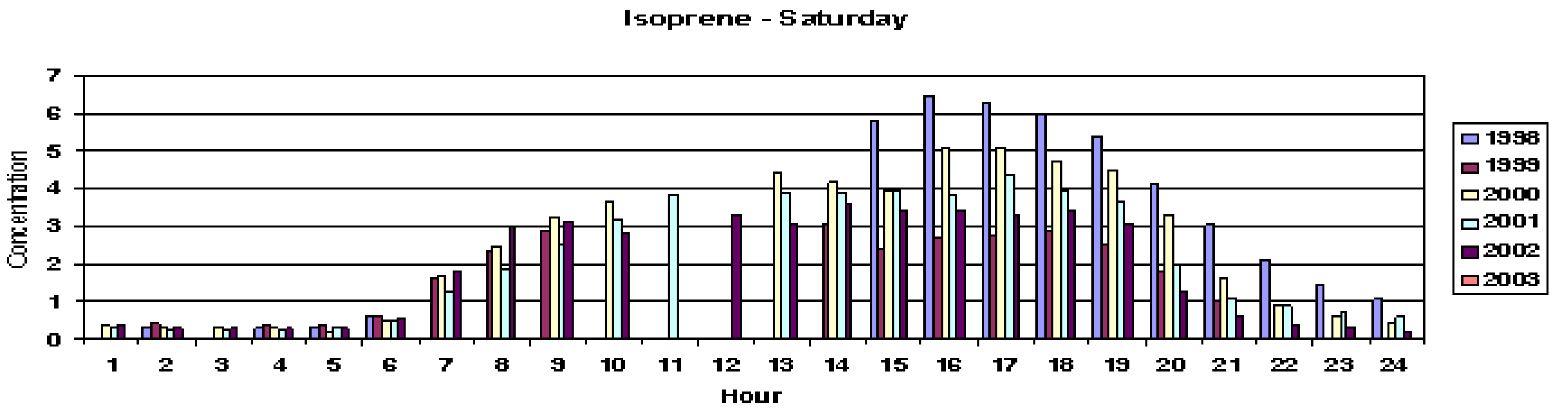
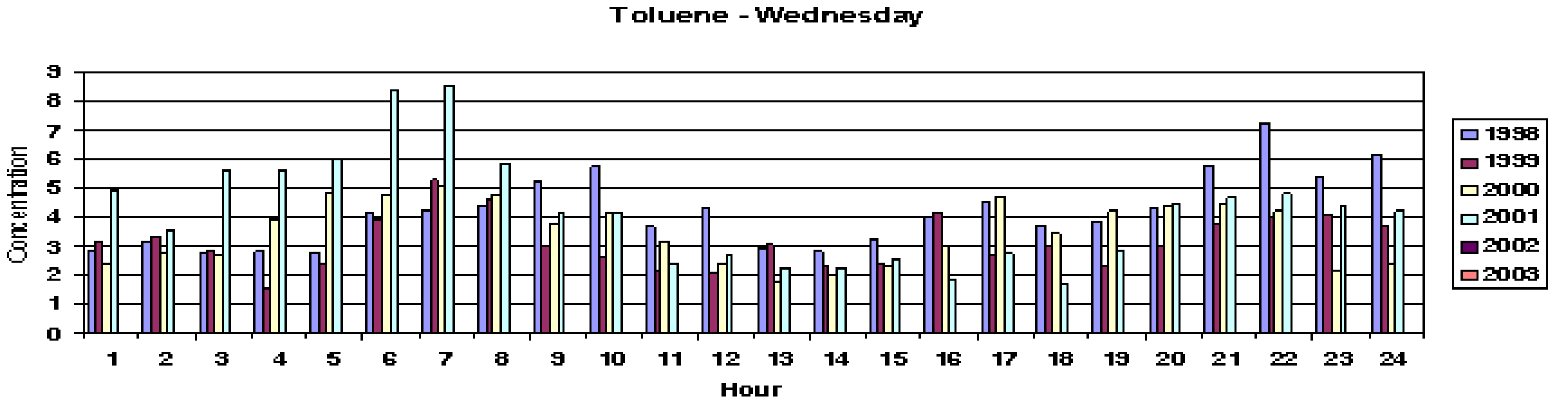


Figure 10.

Toluene (45202) diurnal variation: New Brunswick, NJ



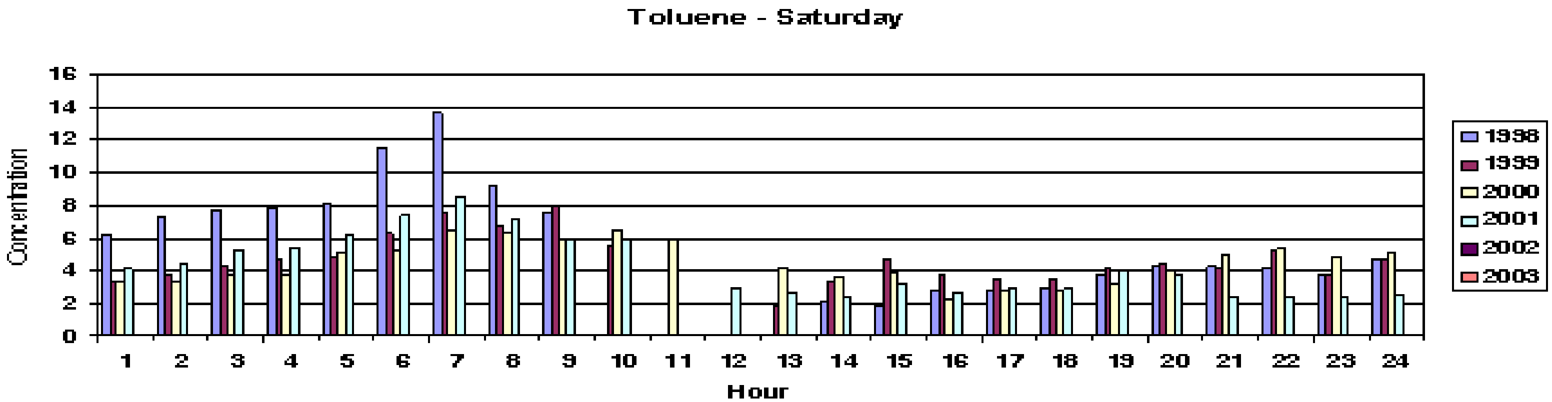
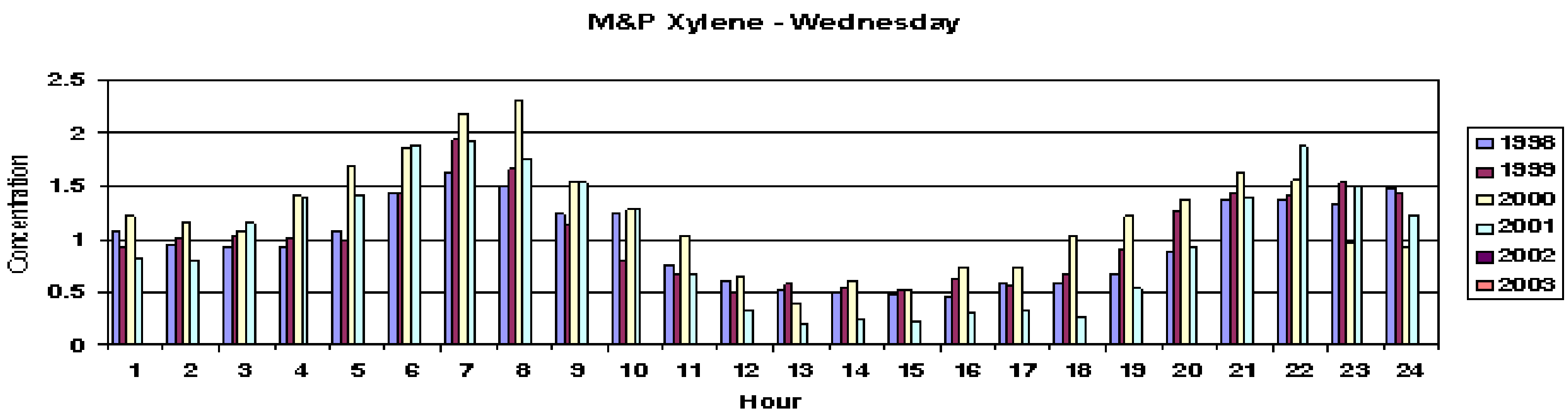


Figure 11.

M&P Xylene (45109) diurnal variation: New Brunswick, NJ



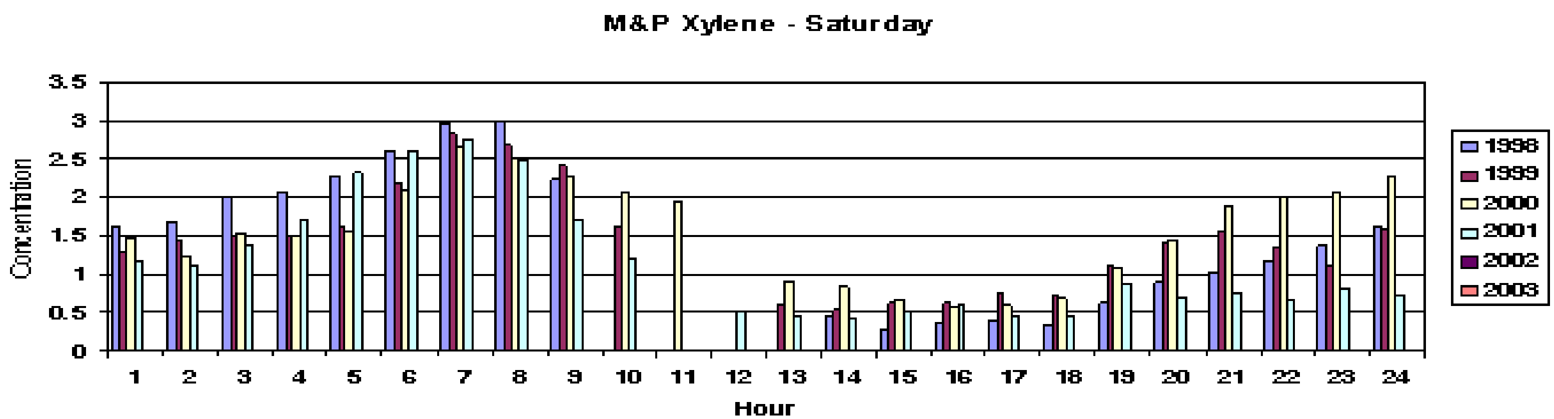
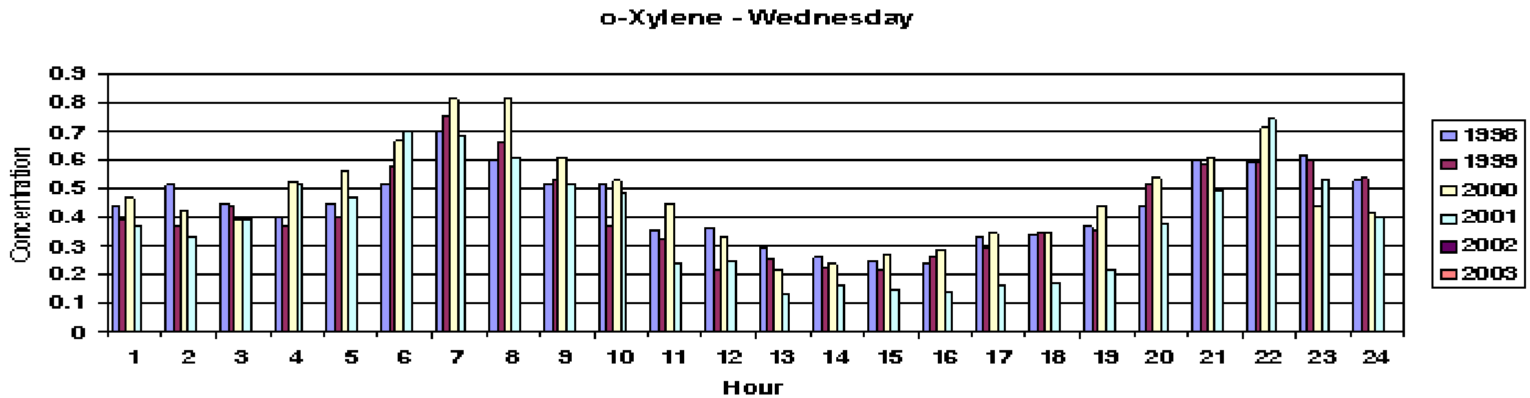


Figure 12.

O-Xylene (45204) diurnal variation: New Brunswick, NJ



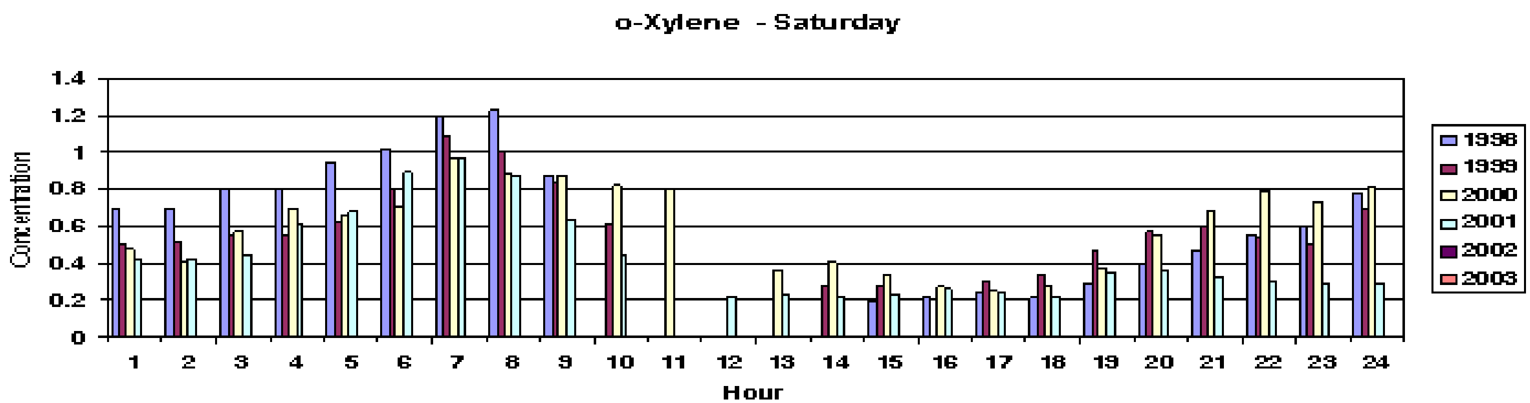
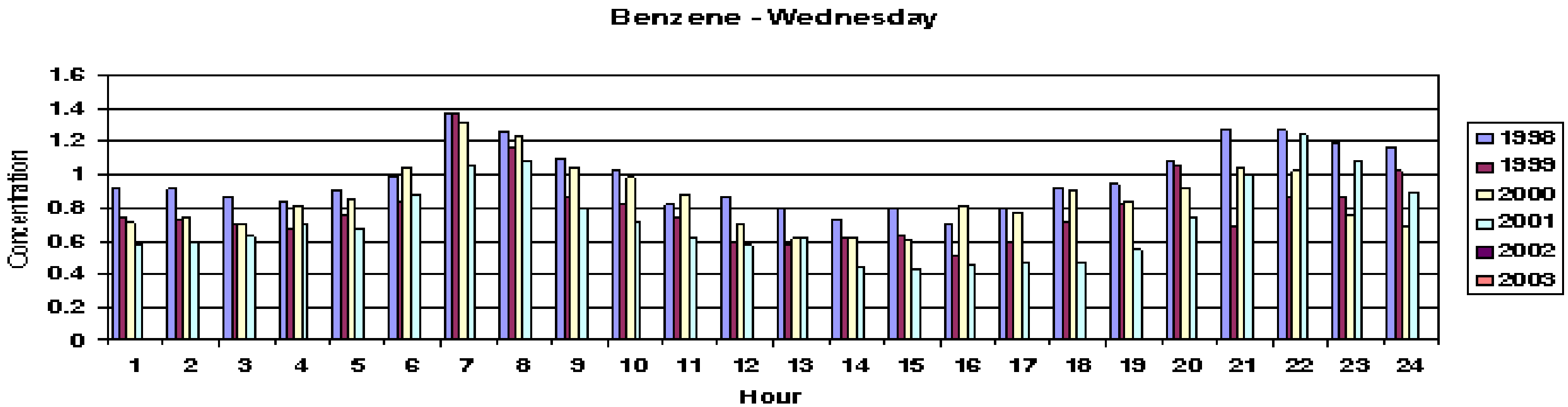


Figure 13.

Benzene (45201) diurnal variation: New Brunswick, NJ



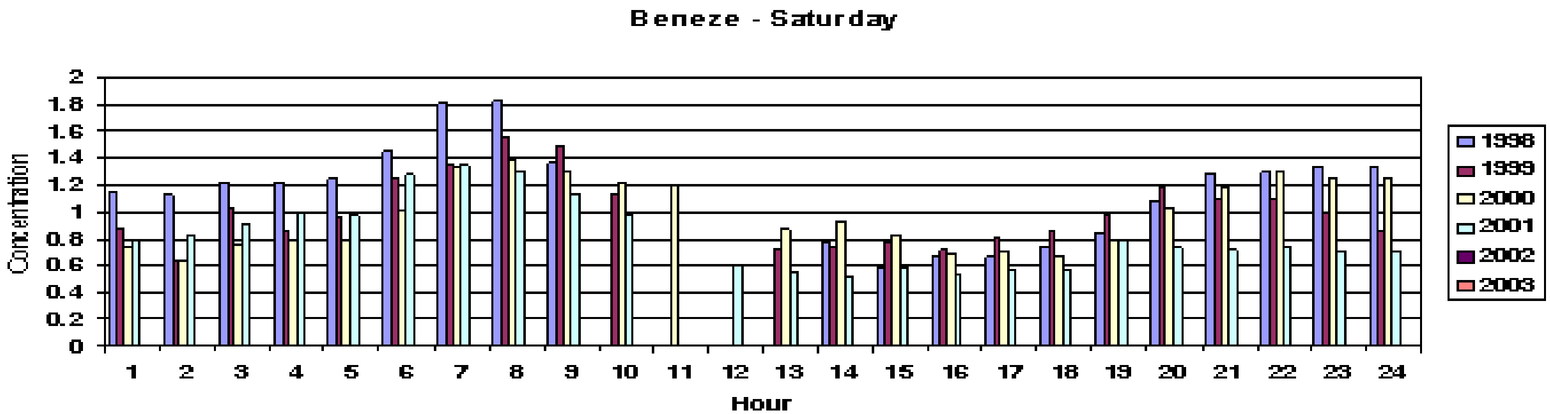


Figure 14.

Ethane (43202) diurnal variation: Bronx, NY

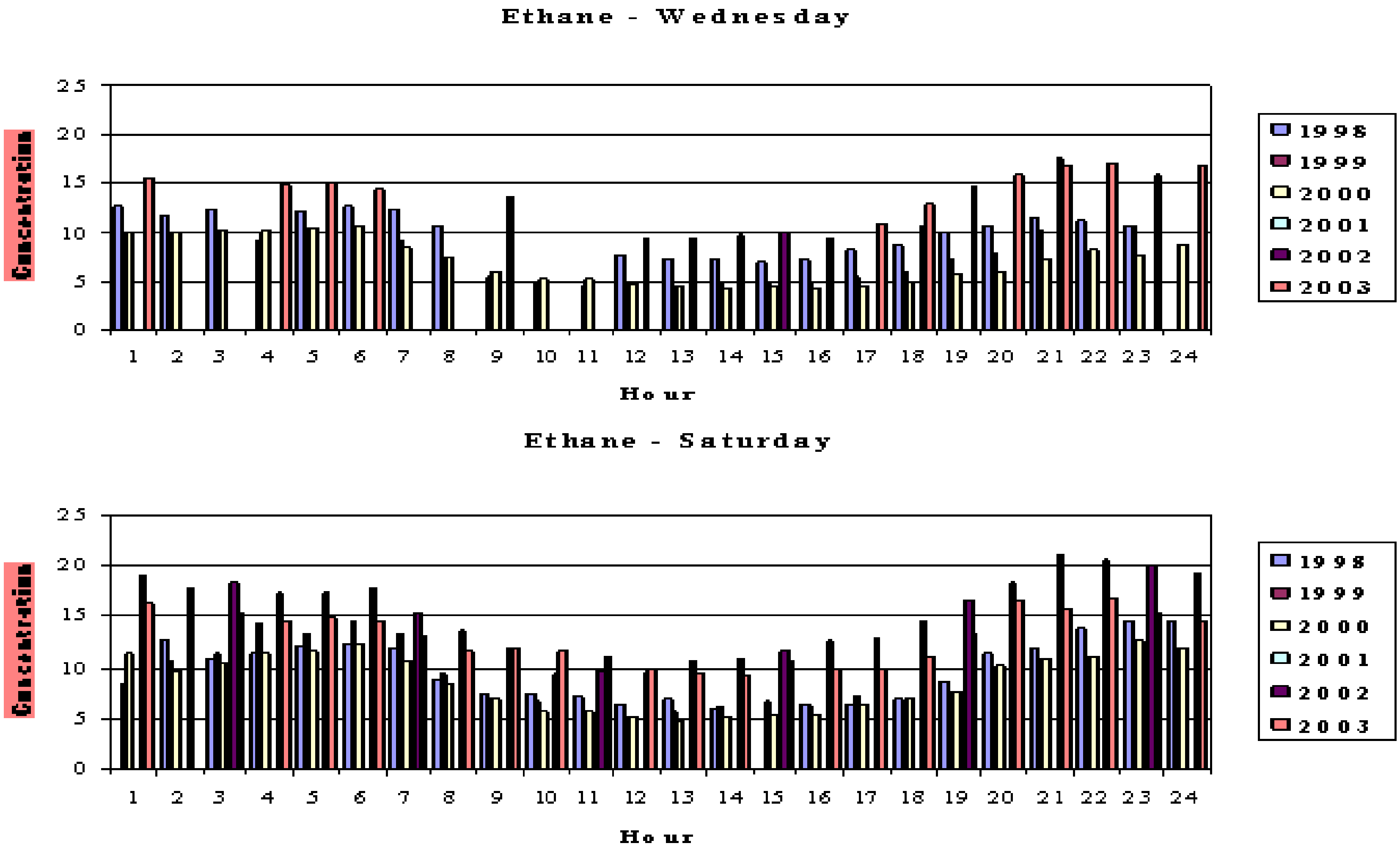
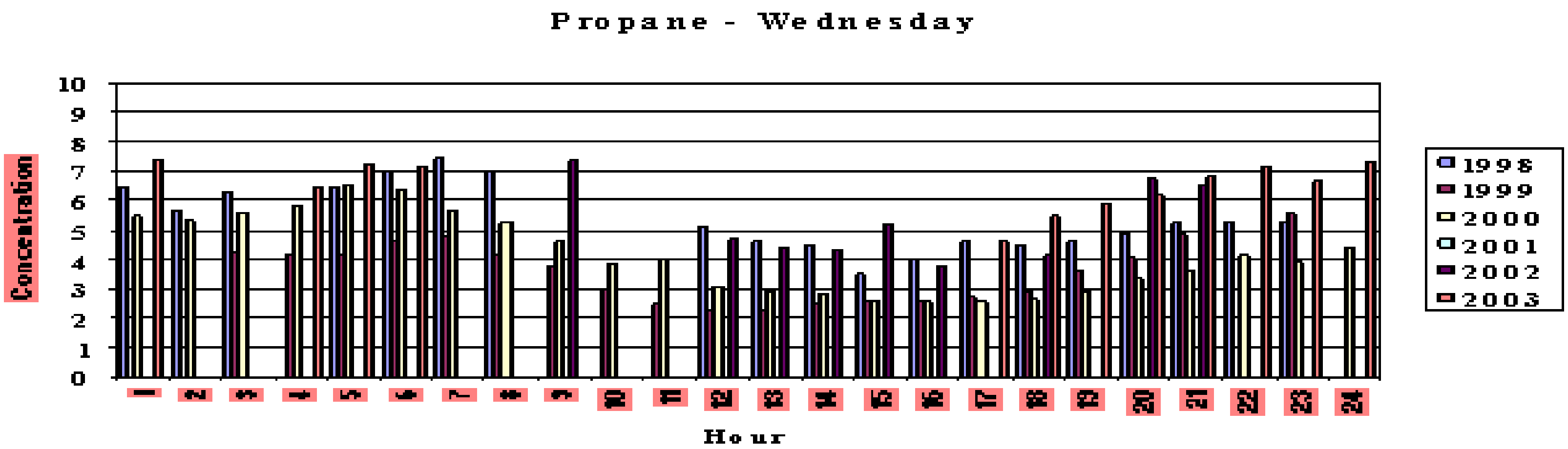


Figure 15.

Propane (43204) diurnal variation: Bronx, NY



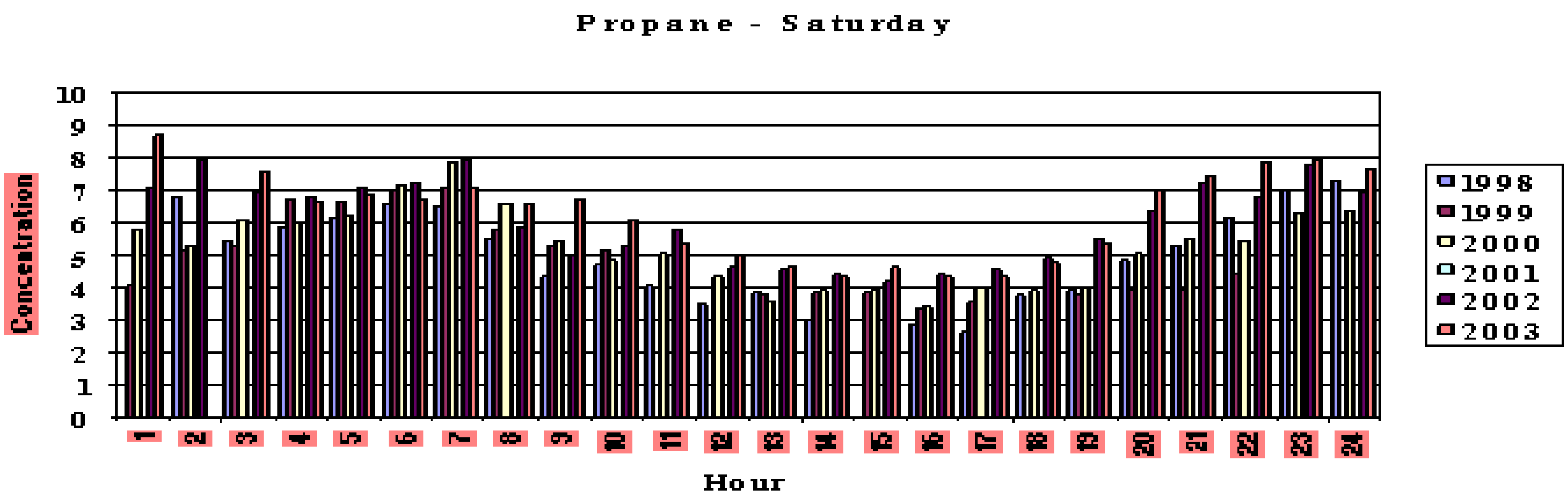


Figure 16.

Isoprene (43243) diurnal variation: Bronx, NY

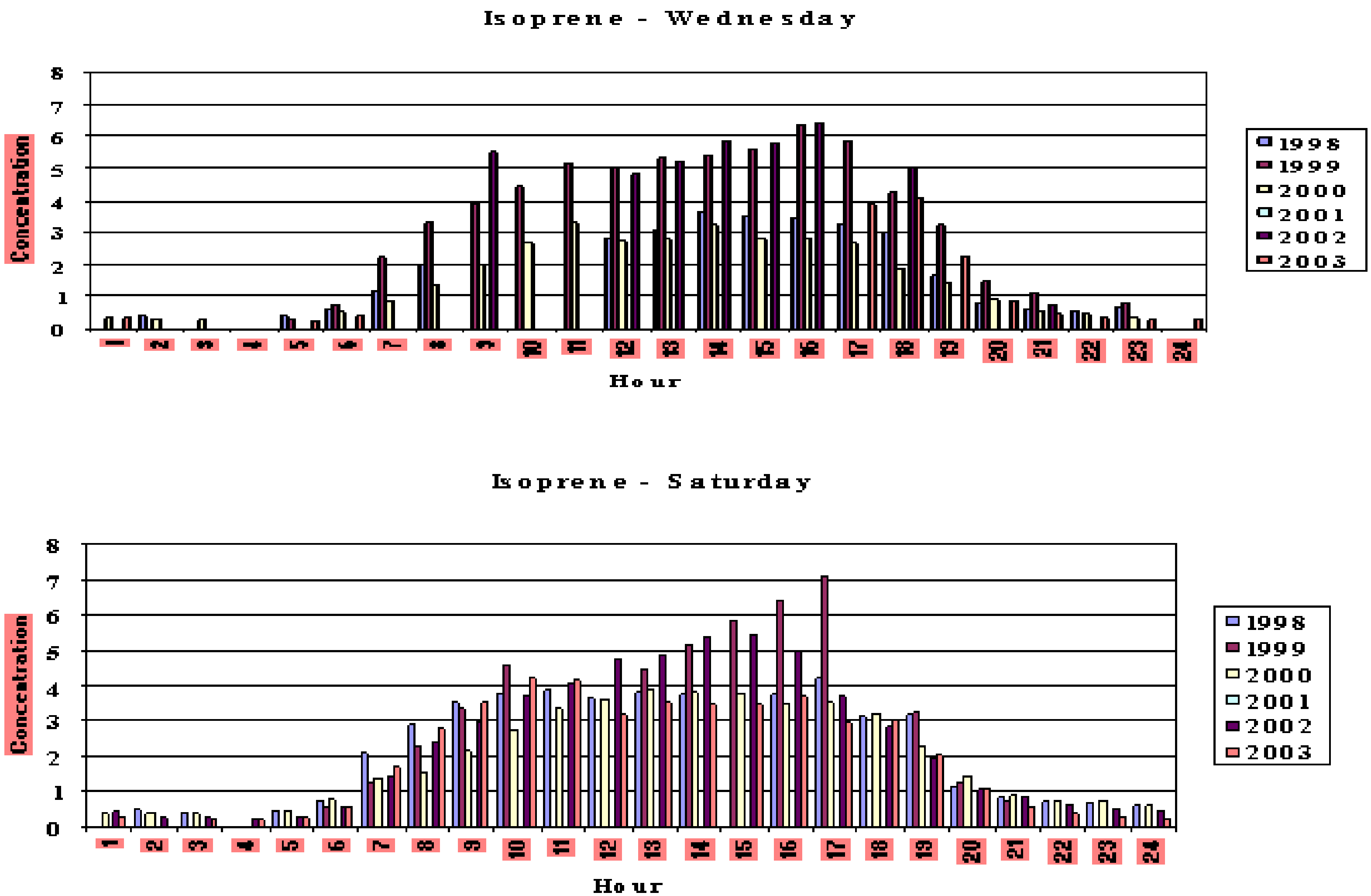


Figure 17.

Toluene (45202) diurnal variation: Bronx, NY

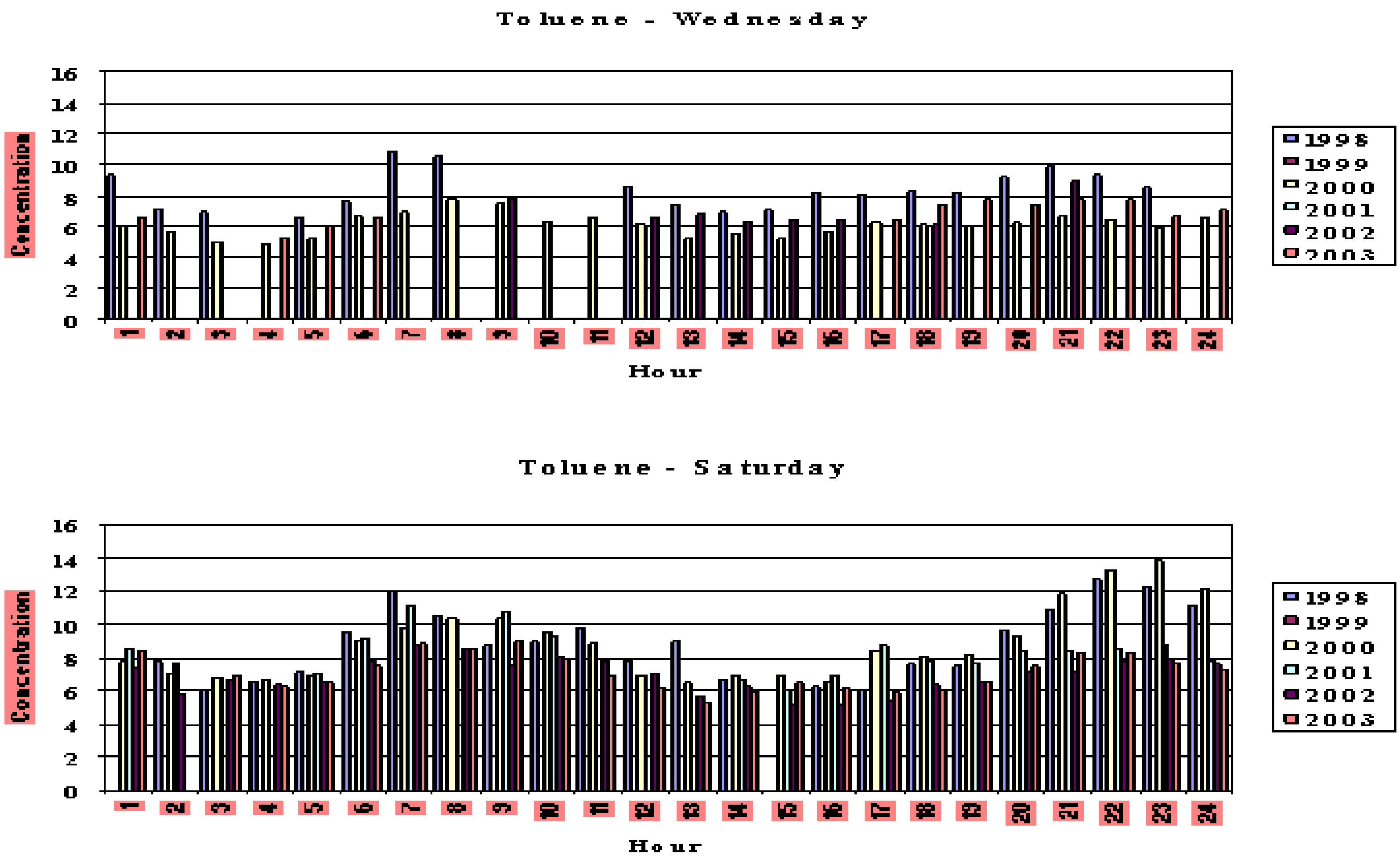
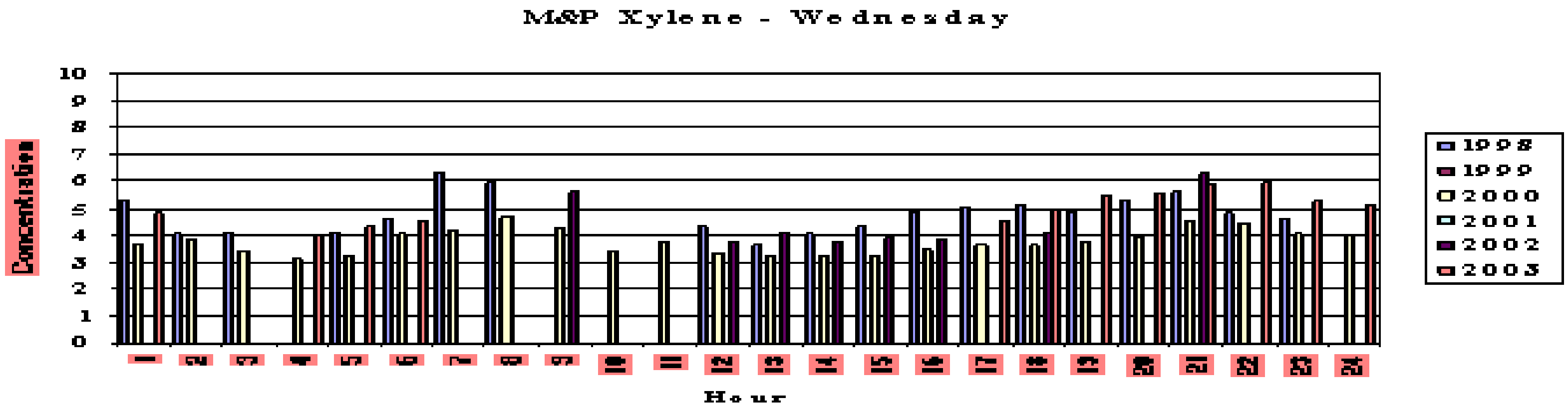


Figure 18.

M&P Xylene (45109) diurnal variation: Bronx, NY



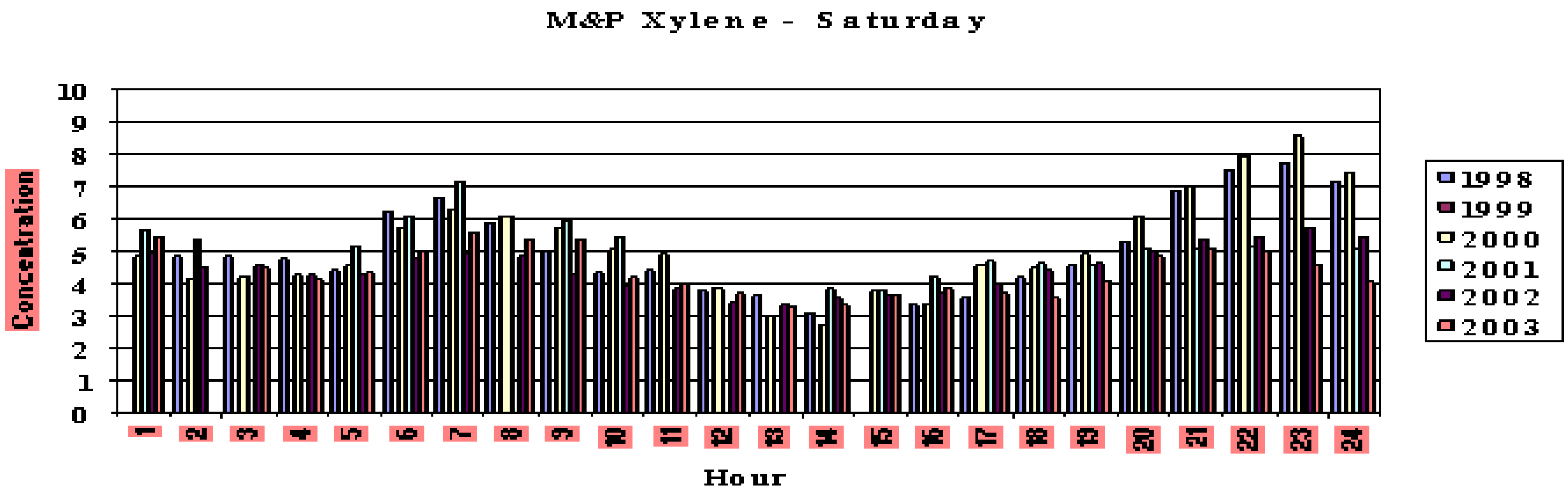
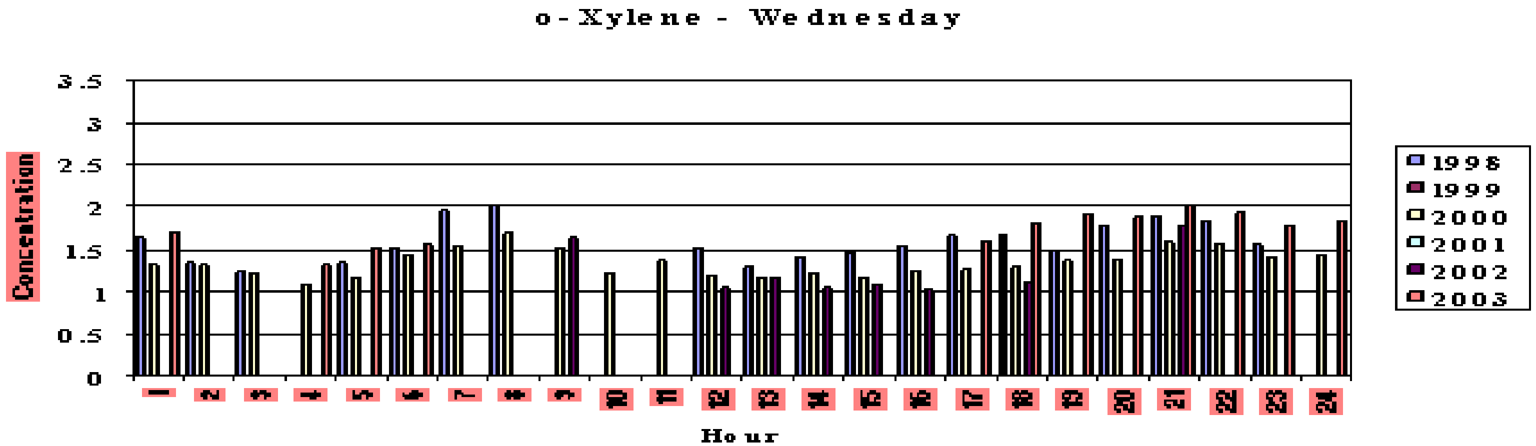


Figure 19.

O-Xylene (45204) diurnal variation: Bronx, NY



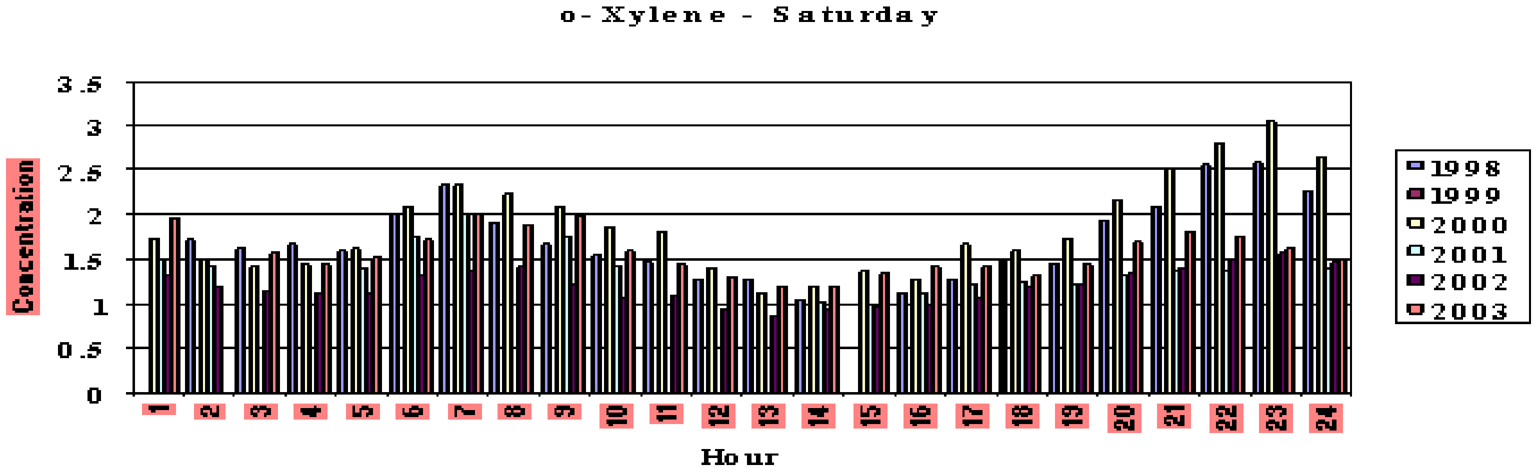


Figure 20.

Beneze (45201) diurnal variation: Bronx, NY

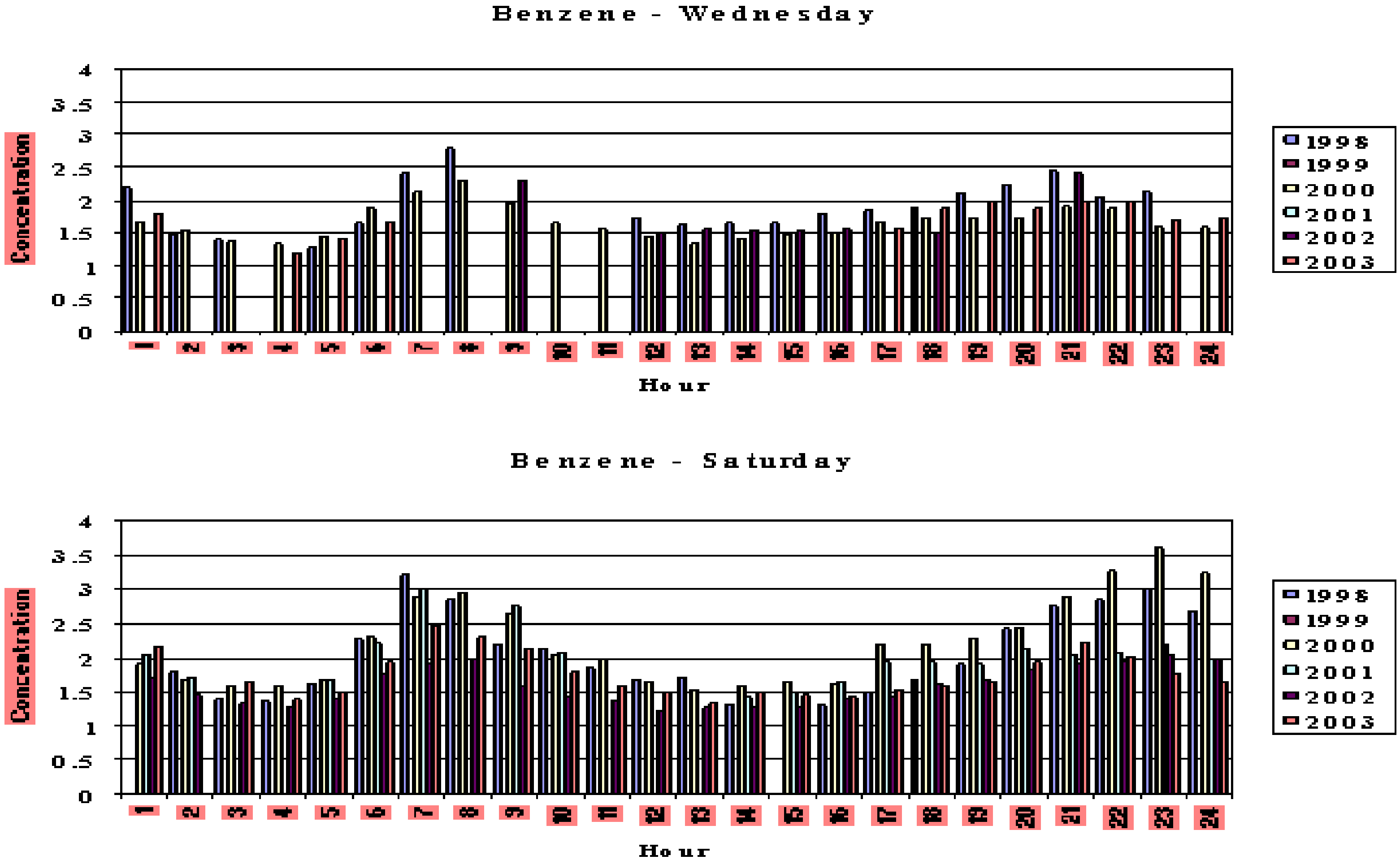
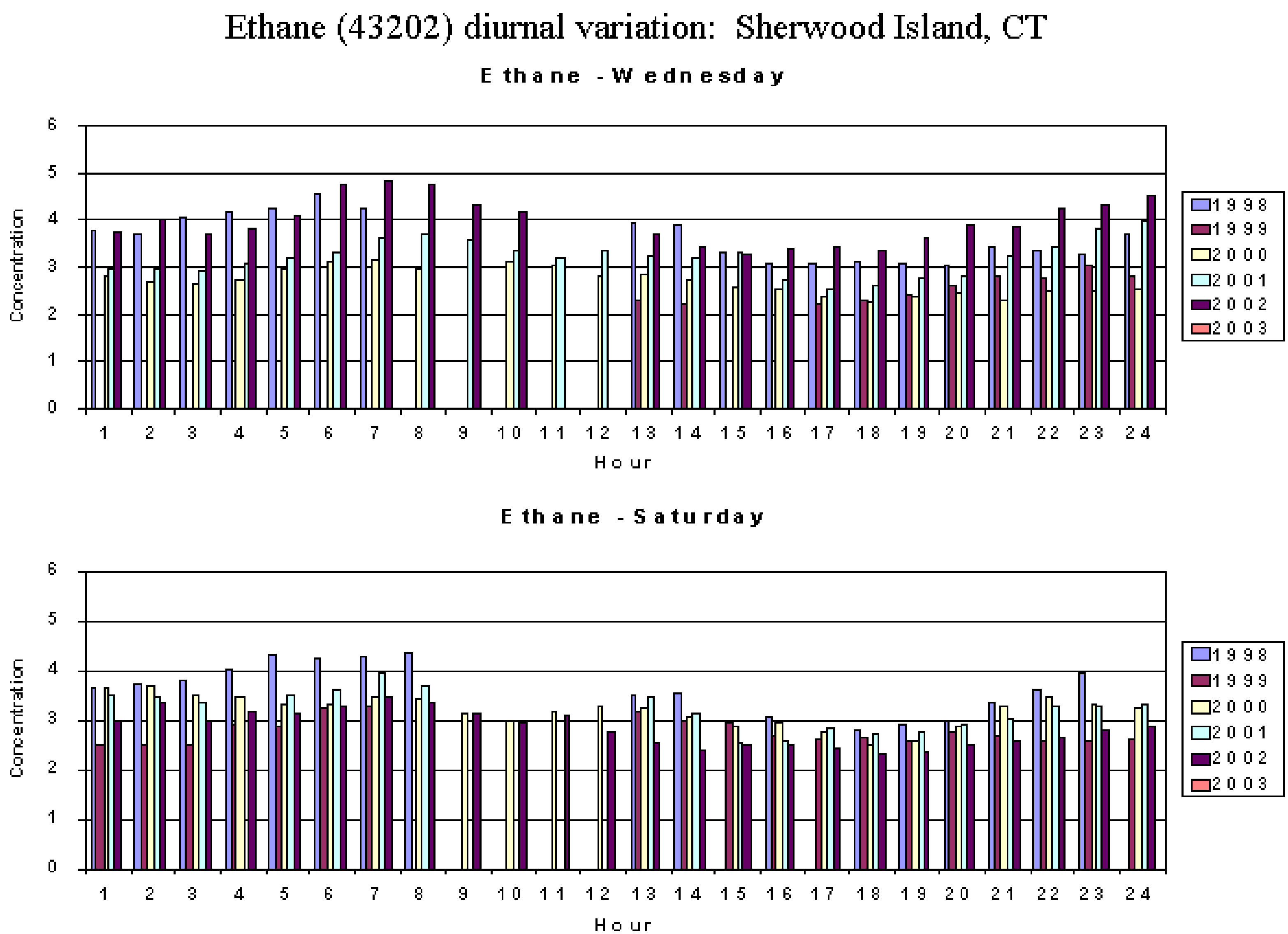


Figure 21.



Ethane (43202) diurnal variation: Sherwood Island, CT
Ethane - Wednesday
Concentration
Hour
1998
1999
2000
2001
2002
2003
Ethane - Saturday
Concentration
Hour
1998
1999
2000
2001
2002
2003

Figure 22.

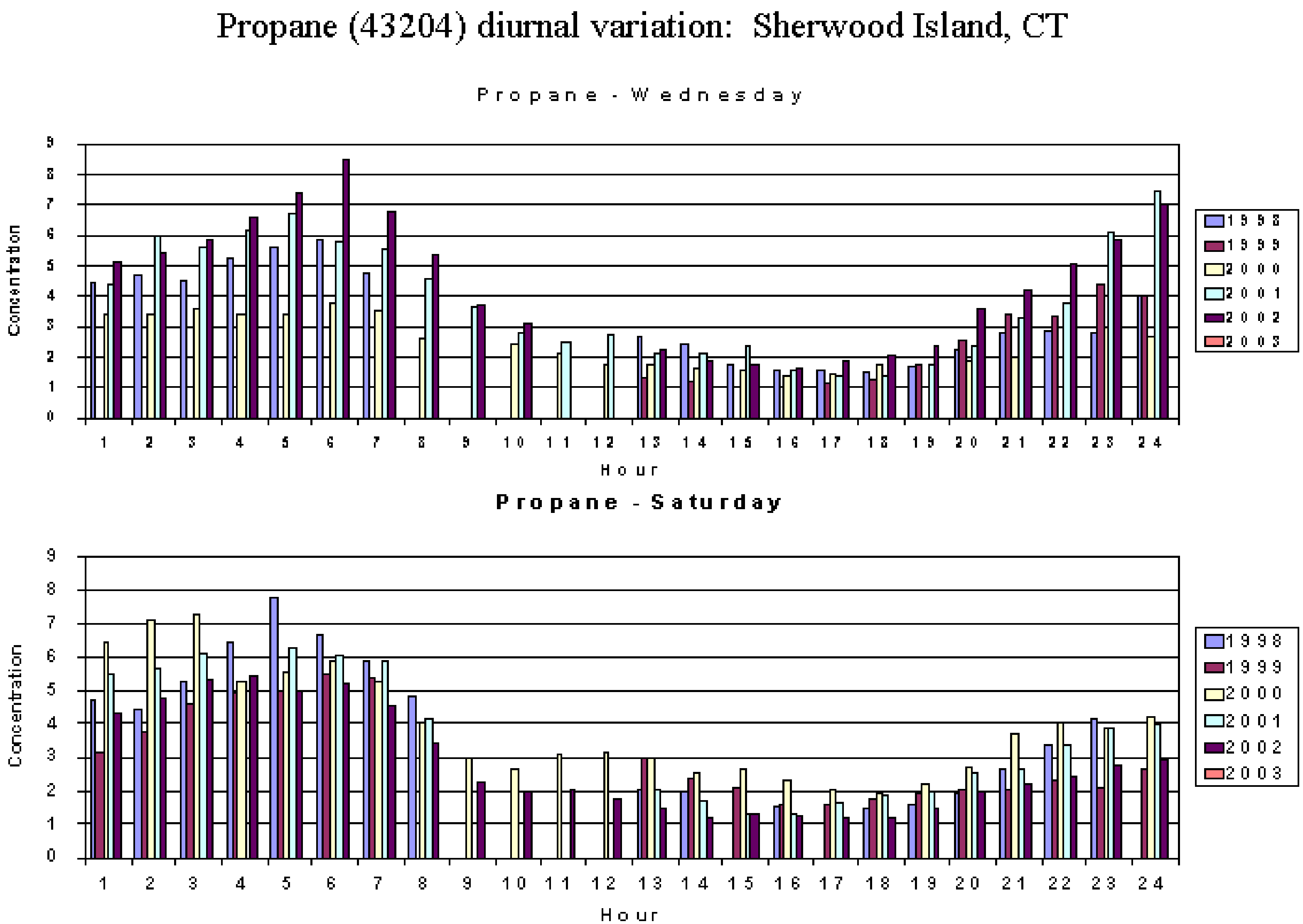

Propane (43204) diurnal variation: Sherwood Island, CT
Propane - Wednesday
Concentration
Hour
1998
1999
2000
2001
2002
2003
Propane - Saturday
Concentration
Hour
1998
1999
2000
2001
2002
2003

Figure 23.

Isoprene (43243) diurnal variation: Sherwood Island, CT

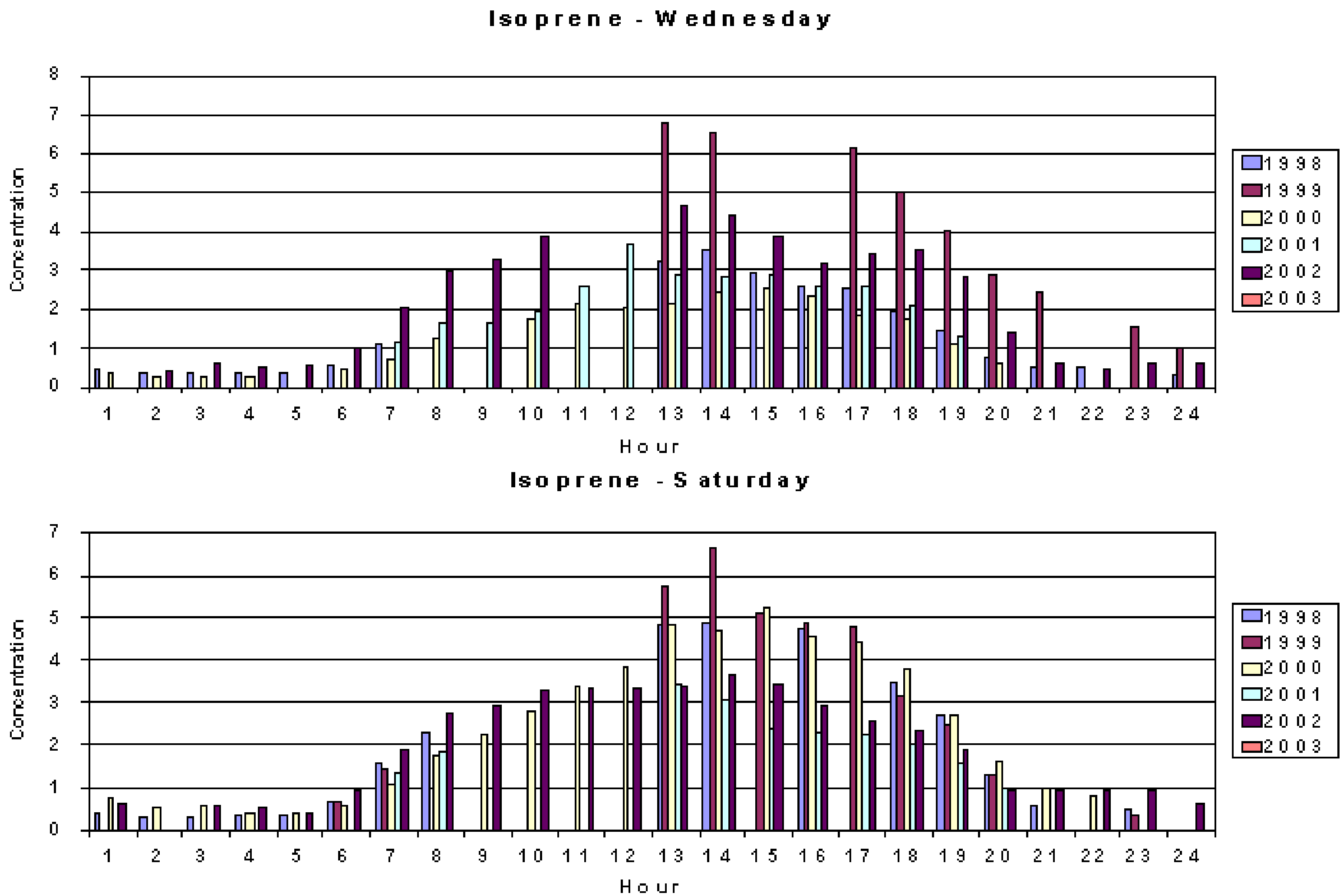
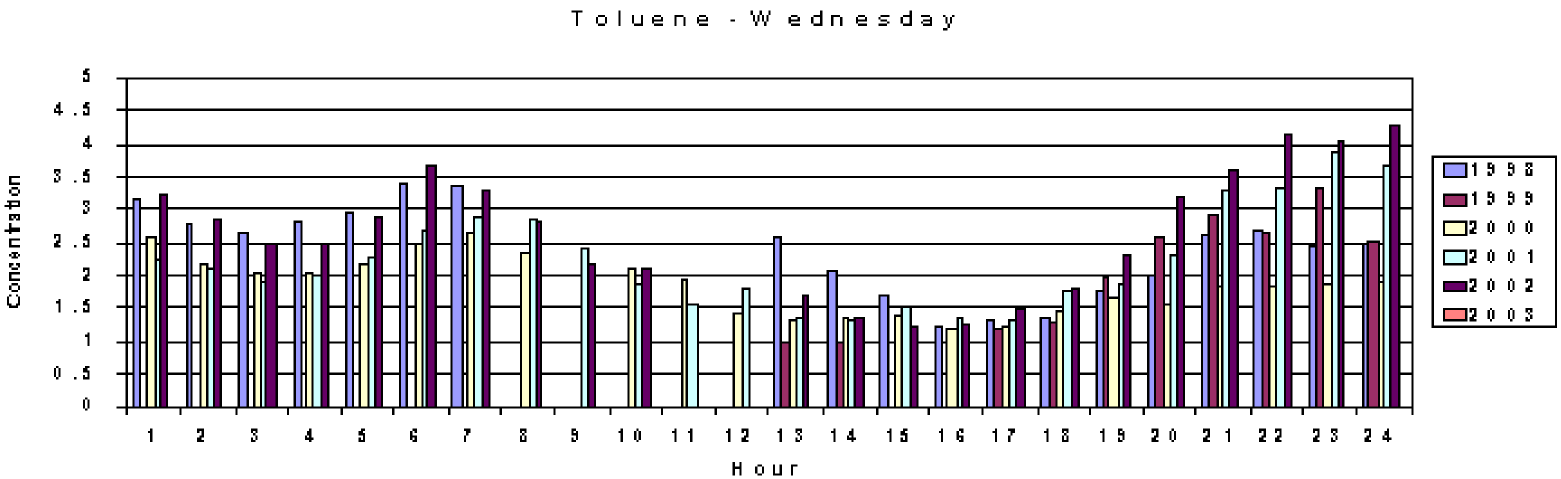


Figure 24.

Toluene (45202) diurnal variation: Sherwood Island, CT



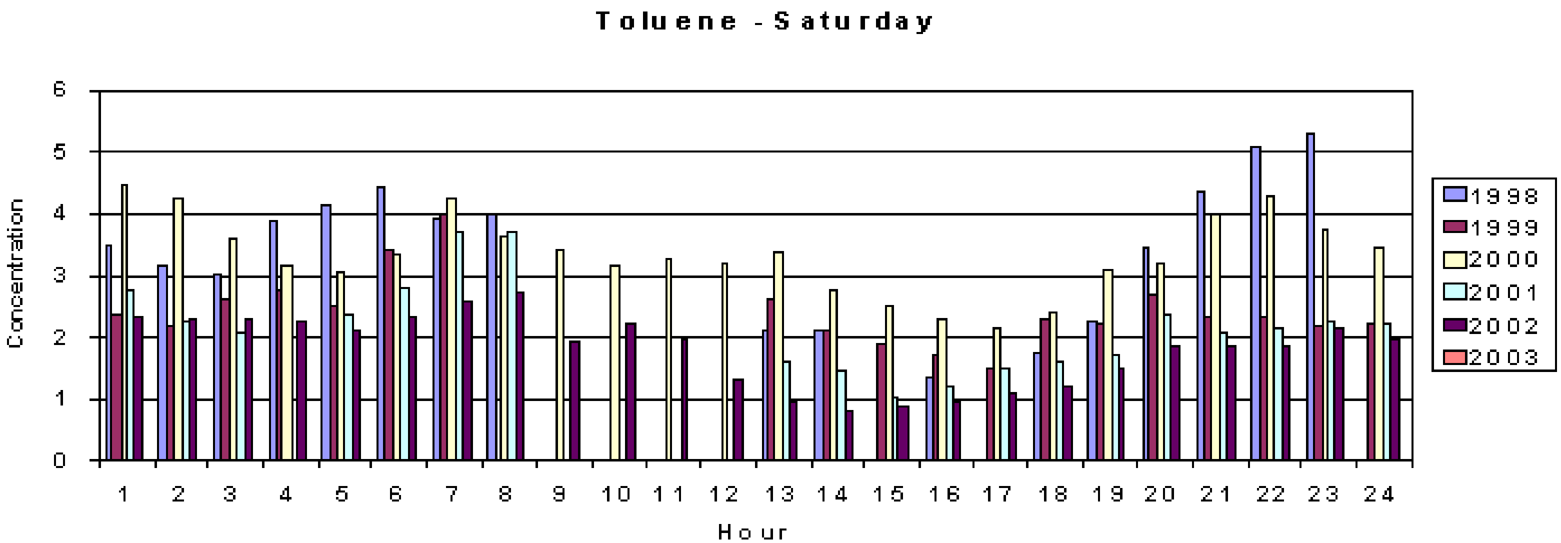


Figure 25.

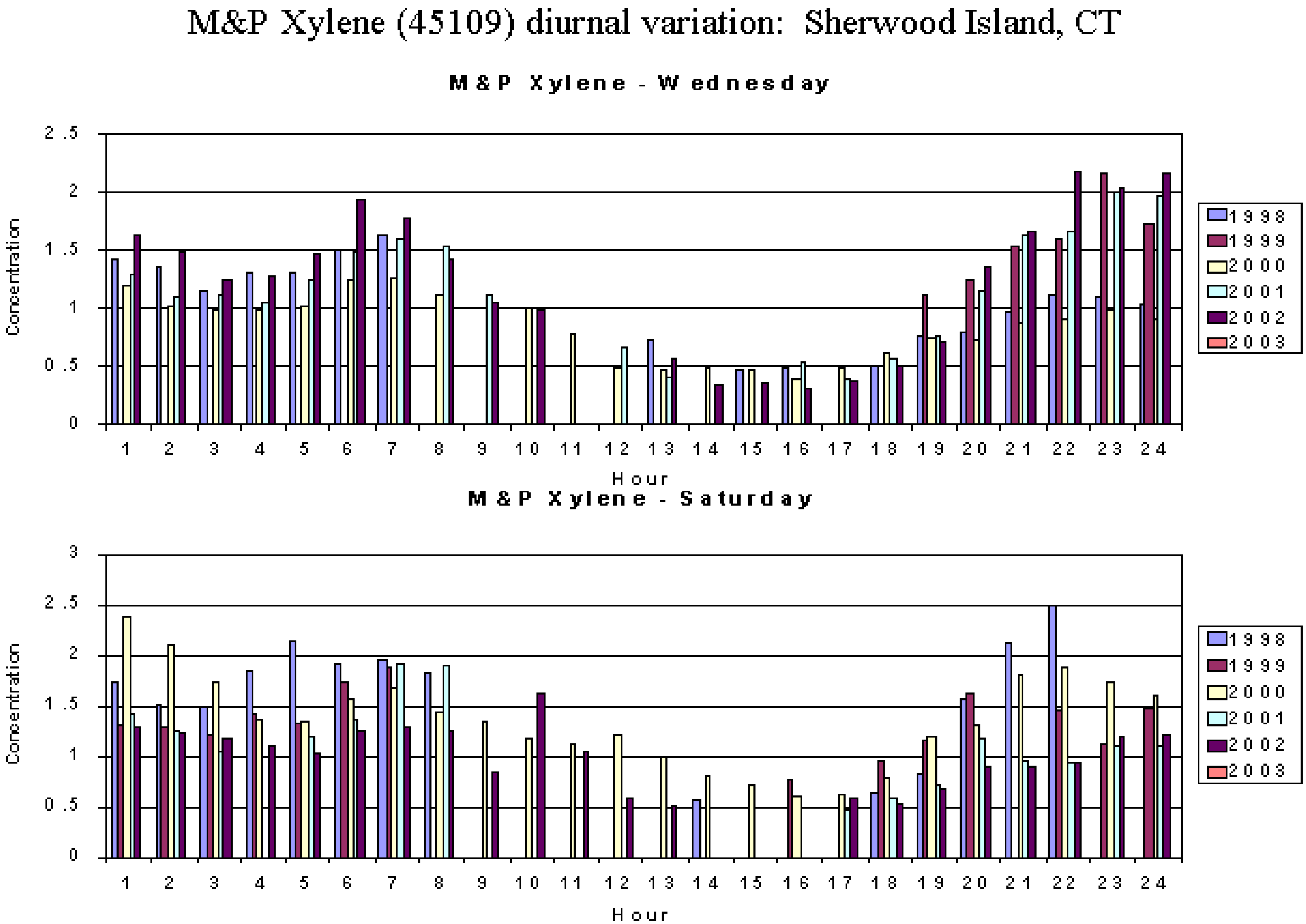

M&P Xylene (45109) diurnal variation: Sherwood Island, CT
M&P Xylene - Wednesday
Concentration
Hour
1998
1999
2000
2001
2002
2003
M&P Xylene - Saturday
Concentration
Hour
1998
1999
2000
2001
2002
2003

Figure 26.

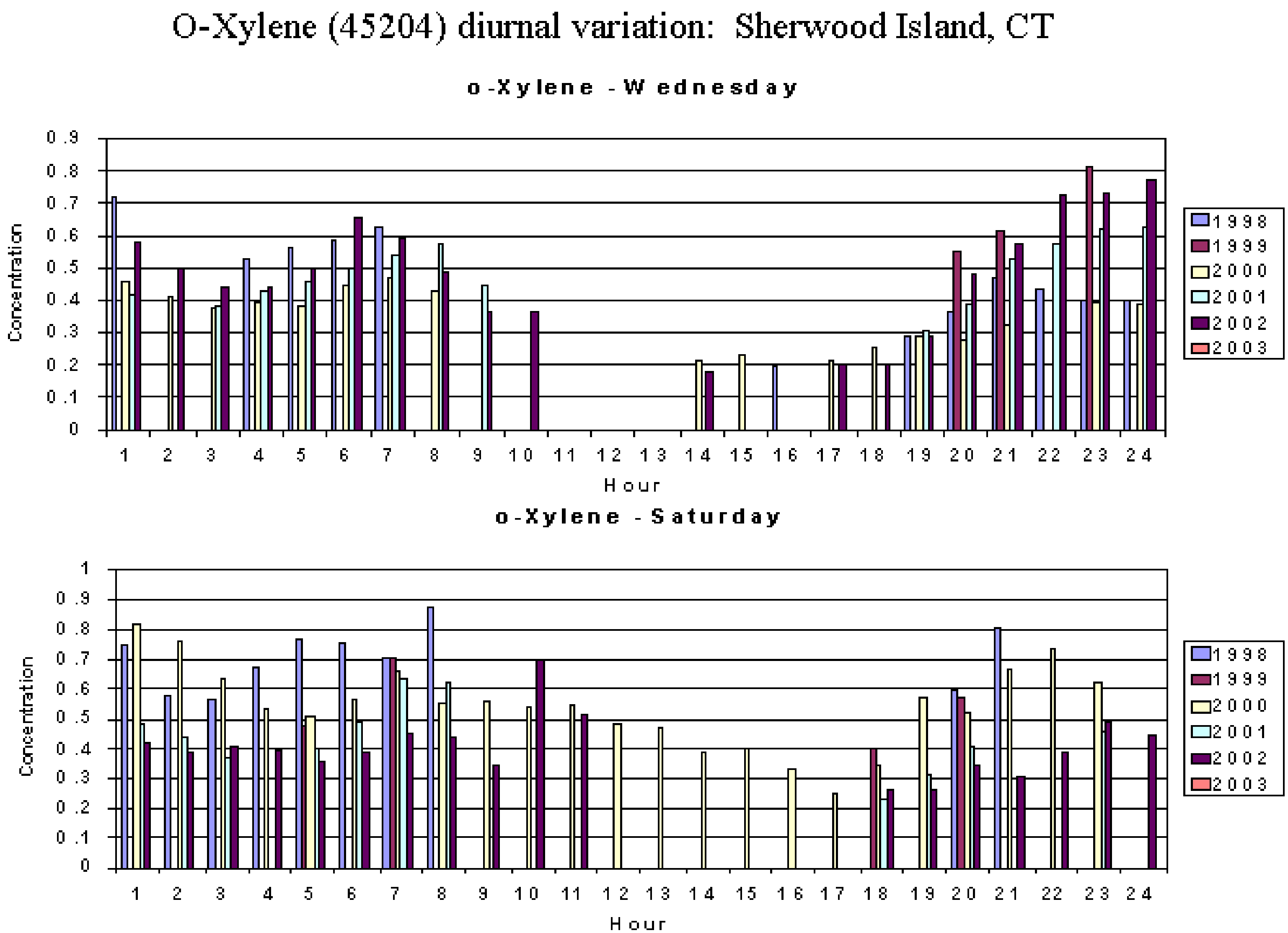
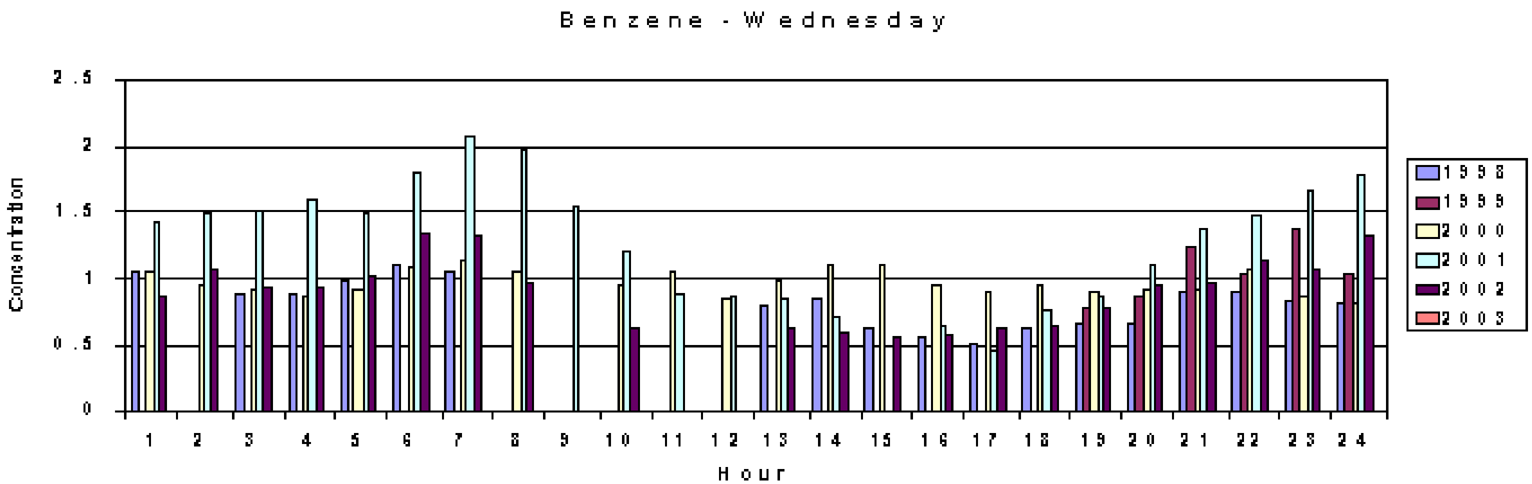
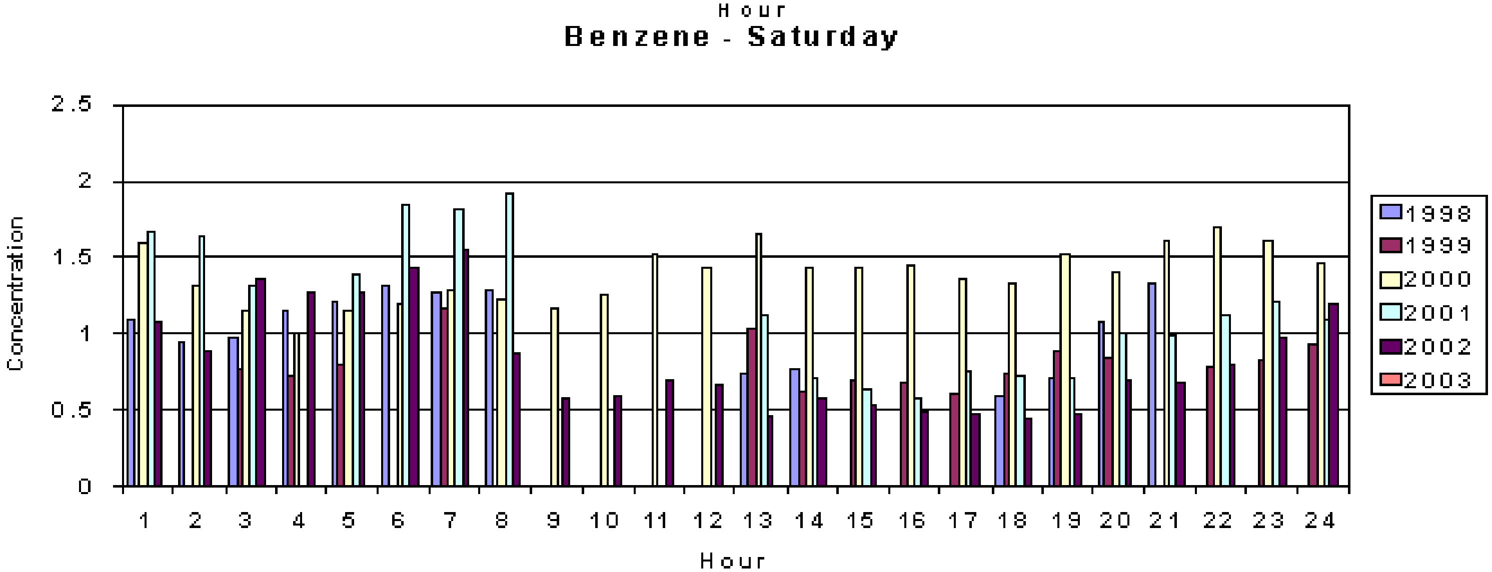

O-Xylene (45204) diurnal variation: Sherwood Island, CT
o-Xylene - Wednesday
Concentration
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
1998
1999
2000
2001
2002
2003
o-Xylene - Saturday
Concentration
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
1998
1999
2000
2001
2002
2003

Figure 27.

Benzene (45201) diurnal variation: Sherwood Island, CT





Appendix B

Analysis of Ozone Precursor, NO_2 and CO, Concentrations over the New York Airshed During 1980 to 2003

The following analysis is based upon data assembled from the USEPA Air Quality System for the period of 1980 to 2003. It should be noted that the number of monitors varied from year to year across the region and every attempt had been made to include those monitors that have been operational for over ten years or more.

Since the analysis pertains to the ozone season, only data from May through October were considered in this study, and the non-parametric seasonal Kendall test[56] was applied to establish the presence or absence of trend in the measured concentrations. While trends are often reported based on the mean or median values, in this study we also report trends in the various percentiles of the measured data so one can assess changes in the distribution of the concentrations. Also shown are the time series of average concentrations over the region, so as to provide the range of concentrations encountered at these locations.

Trends in monthly NO_2 concentrations at New York airshed sites in Connecticut, New Jersey, and New York, 1985-2003:

- Eleven locations with hourly NO_2 concentration data (Table B-1).
- Examined trends using the seasonal Kendall test during "ozone season" (May-October) months from 1985-2003 (note that three sites – Rider University, Rutgers University, and Bronx Botanical Gardens – have short time records, but results are listed here anyway). Trend estimates are listed in Table B-2.
- The trends at Rider University are about zero; concentrations at the Elizabeth site may be increasing slightly, but not significantly.
- The trends at all other sites are decreasing.
- The trends at the two Connecticut sites and the Chester site are roughly a factor of two smaller than those at the New York and other New Jersey sites.
- Times series of average NO_2 concentrations are shown by state in Figures B1-B3.

[56] Mirsch, R. M. and Slack, J. R. 1984, "A nonparametric trend test for seasonal data with serial dependence", Water Resources Research, 20, 727-732

Table B-1. NO_2 monitoring sites in the New York Airshed and sampling period.

USEPA AQS ID	Name	Date range
090031003	East Hartford, CT	1981-2003
090091123	New Haven, CT	1981-2003
340131003	East Orange, NJ	1980-2003
340170006	Bayonne, NJ	1983-2003
340210005	Rider University, NJ	1994-2003
340230011	Rutgers University, NJ	1994-2003
340273001	Chester, NJ	1983-2003
340390004	Elizabeth, NJ (NJ Turnpike)	1980-2003
360050083	Bronx Botanical Gardens, NY	1995-2003
360590005	Eisenhower Park, NY	1980-2003
360610056	New York, NY (PS 59)	1986-2003

Table B-2. Trends in monthly NO_2 concentrations during the "ozone season" months (May-October) from 1985-2003 using the seasonal Kendall test, in parts per billion per year. Trends are listed for the mean, median, and 5th, 25th, 75th, and 95th percentiles, and are color-coded by significance (p) level.

USEPA AQS ID	Name	5%	25%	mean	median	75%	95%
090031003	East Hartford	-0.15	-0.25	-0.29	-0.30	-0.33	-0.41
090091123	New Haven	-0.14	-0.24	-0.29	-0.27	-0.33	-0.50
340131003	East Orange	-0.30	-0.46	-0.63	-0.57	-0.74	-1.14
340170006	Bayonne	-0.25	-0.42	-0.62	-0.60	-0.70	-1.04
340210005	Rider University	0.00	0.00	0.05	0.00	0.00	0.00
340230011	Rutgers University	0.00	-0.20	-0.54	-0.50	-0.75	-1.00
340273001	Chester	0.00	-0.22	-0.28	-0.29	-0.36	-0.57
340390004	Elizabeth (NJ Tpke)	0.18	0.33	0.25	0.42	0.25	0.00
360050083	Bronx Botanical	-0.40	-0.50	-0.69	-0.67	-1.00	-1.33
360590005	Eisenhower Park	-0.25	-0.54	-0.76	-0.75	-1.00	-1.32
360610056	New York (PS 59)	-0.47	-0.67	-1.00	-0.88	-1.20	-1.86

$p < 0.05$ - Significant
$0.05 < p < 0.1$ – Moderately Significant
$p > 0.1$ – Not Significant

Figure B-1.

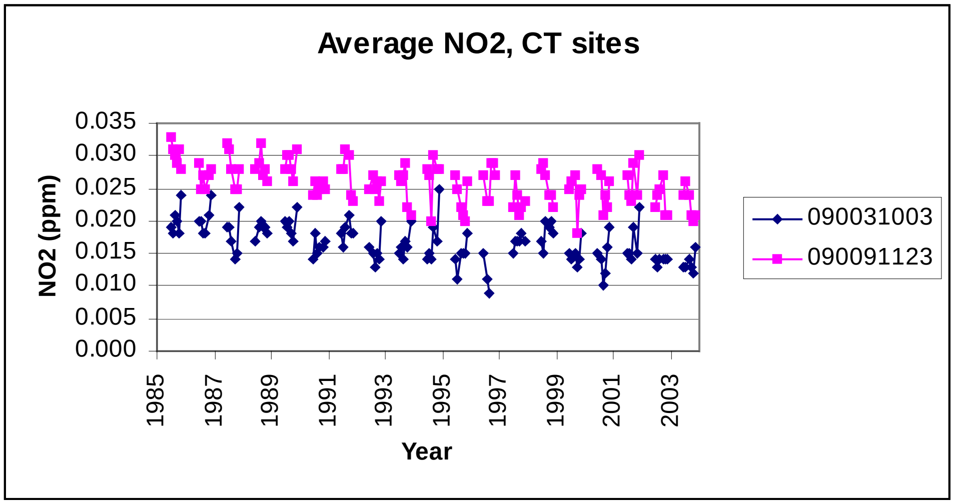


Figure B-2.

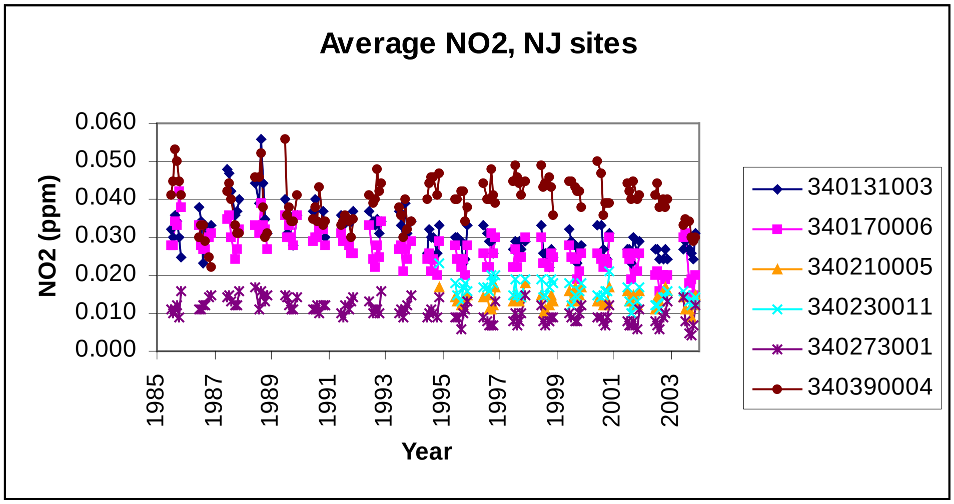
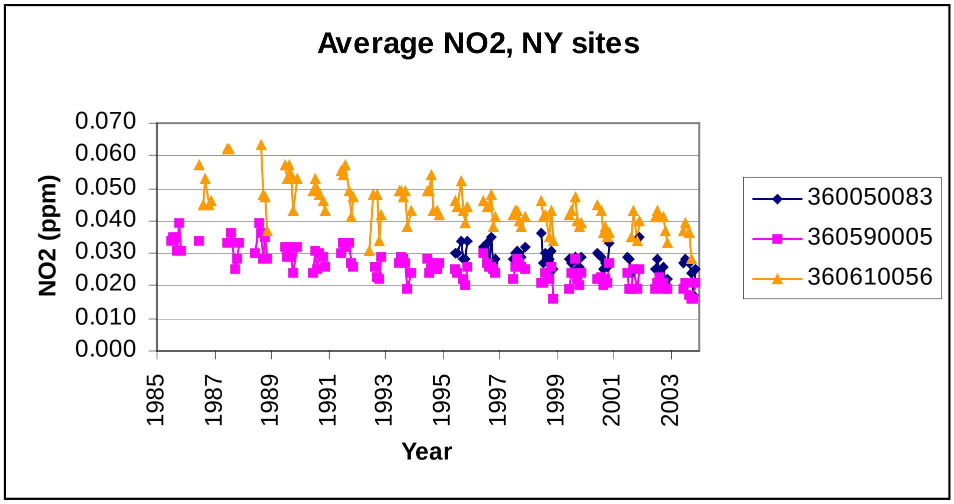


Figure B-3.



Trends in monthly CO concentrations at New York airshed sites in Connecticut, New Jersey, and New York, 1985-2003:

- Fourteen locations with hourly CO concentration data (Table B-3).
- Examined trends using the seasonal Kendall test during from 1985-2003 (note that four sites – Hartford, Fort Lee, and the two Manhattan sites – have short time records, but results are listed here anyway). Trend estimates are listed in Table B-4.
- Although there is evidence that the lowest CO values are not decreasing much (possibly due in part to instrument detection limits), CO concentrations are decreasing substantially at all sites.
- Times series of average CO are shown by state in Figures B-4-B-6.

Table B-3. CO monitoring sites in the New York Airshed and sampling period.

USEPA AQS ID	Name	Date range
090010004	Bridgeport, CT	1980-2003
090010020	Stamford, CT	1980-2003
090030013	Hartford, CT (Flatbush Ave.)	1987-2002
090030017	Hartford, CT (Morgan St.)	1984-2003
340030004	Fort Lee, NJ	1986-2003
340035001	Hackensack, NJ	1980-2003
340171002	Jersey City, NJ	1980-2003
340232003	Perth Amboy, NJ	1980-2003
340252001	Freehold, NJ	1980-2003
340270003	Morristown, NJ	1980-2003
340390003	Elizabeth, NJ	1980-2003
360470071	Brooklyn, NY (MTA)	1984-2003
360610056	New York, NY (PS 59)	1989-2003
360610062	New York, NY (Canal St.)	1980-2001

Table B-4. Trends in monthly CO concentrations during the "ozone season" months (May-October) from 1985-2003 using the seasonal Kendall test, in ppb yr^{-1}. Trends are listed for the mean, median, and 5th, 25th, 75th, and 95th percentiles, and are color-coded by significance (p) level.

USEPA AQS ID	Name	5%	25%	mean	median	75%	95%
090010004	Bridgeport	0	-6	-33	-27	-50	-82
090010020	Stamford	0	-11	-48	-38	-70	-133
090030013	Hartford (Flatbush Ave.)	0	0	-14	-7	-17	-44
090030017	Hartford (Morgan St.)	-6	-35	-70	-62	-100	-157
340030004	Fort Lee	-6	-31	-63	-53	-83	-150
340035001	Hackensack	-2	-15	-43	-32	-56	-106
340171002	Jersey City	-4	-33	-101	-77	-150	-267
340232003	Perth Amboy	-2	-20	-48	-40	-67	-121
340252001	Freehold	1	-16	-55	-40	-85	-149
340270003	Morristown	-2	-21	-72	-50	-103	-203
340390003	Elizabeth	-13	-36	-89	-67	-123	-238
360470071	Brooklyn (MTA)	-23	-64	-154	-117	-200	-400
360610056	New York (PS 59)	-14	-33	-64	-50	-90	-145
360610062	New York (Canal St.)	-40	-100	-167	-155	-217	-325

$p < 0.05$ - Significant
$0.05 < p < 0.1$ – Moderately Significant
$p > 0.1$ – Not Significant

Figure B-4.

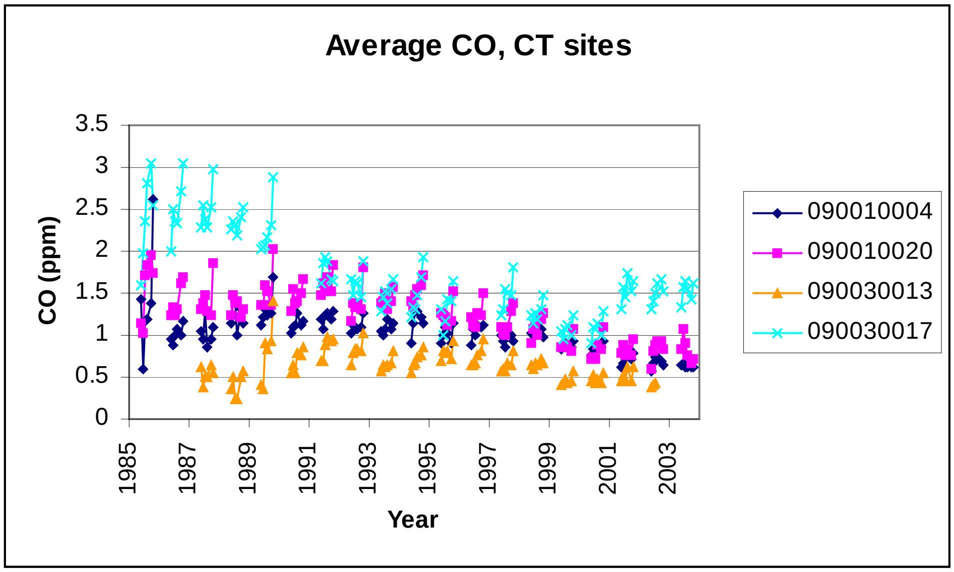


Figure B-5.

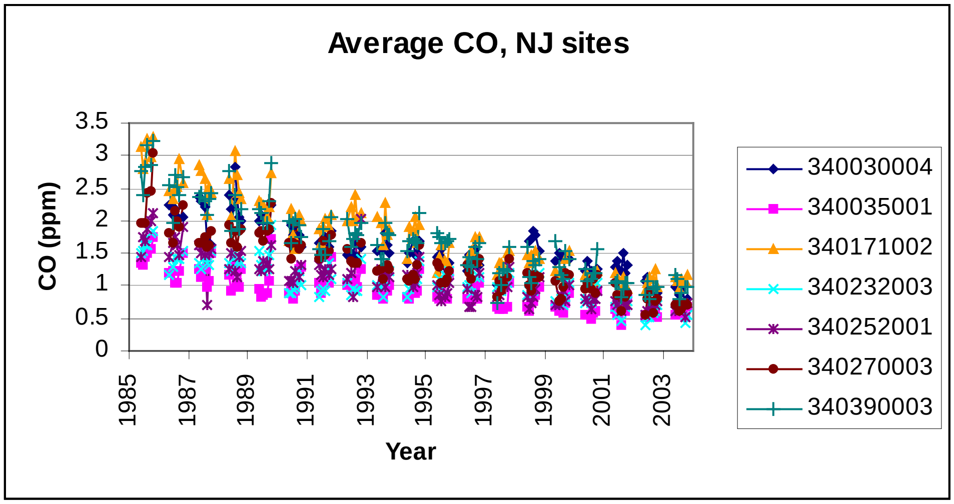


Figure B-6.